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ELECTROLYTE BALANCE AND FLUID THERAPY*

WENDELL T. CARAWAY, PH.D.

The Author. *Wendell T. Caraway, Ph.D., of Providence, R. I. Biochemist, Department of Pathology, Rhode Island Hospital.*

ELECTROLYTE IMBALANCE is a complication usually caused by or associated with some other pathological process. For this reason, the subject is not easy to evaluate as a separate pathological entity, nor should it be so evaluated. The large body of information that has been built up on the subject cuts across considerations of various diseases and various specialties; there are no readily memorized rules of thumb that may be applied clinically without risking disastrous results. The necessity for careful and individual evaluation of each case makes imperative a thorough understanding of the basic principles from which one may proceed to a logical regimen of therapy. The discussion which follows is intended as a review of fundamental principles and their practical application to the problems most frequently encountered in electrolyte disturbances.

ELECTROLYTES AND THE MILLIEQUIVALENT SYSTEM

An electrolyte is a substance, which, when dissolved in water, dissociates into *ions*. A good example of an electrolyte is sodium chloride. This salt, when dissolved in water, dissociates to form an equal number of positively charged *cations* (Na+) and negatively charged *anions* (Cl−). Most inorganic salts as well as the sodium and potassium salts of organic acids form ions in aqueous solutions. Thus,

$NaCl \longrightarrow Na^+ + Cl^-$
$KCl \longrightarrow K^+ + Cl^-$
$NaHCO_3 \longrightarrow Na^+ + HCO_3^-$
Sodium Lactate $\longrightarrow Na^+ +$ Lactate−
$CaCl_2 \longrightarrow Ca^{++} + 2\ Cl^-$, etc.

Solutions of electrolytes will conduct an electric current, hence the name electrolyte. If an ion carries a single charge, it is said to be *monovalent* (Na+, K+, Cl−, HCO_3^-). If it carries two charges it is *divalent* (Ca++, Mg++, SO_4^{--}, HPO_4^{--}). The important thing to note is, that in any solution, there must always be the same *number* of positive and negative charges. In other words, the solution must be electrically *neutral*. In a solution containing only sodium chloride and sodium bicarbonate, for example, the total number of sodium ions is equal to the sum of the chloride and bicarbonate ions.

In problems of electrolyte balance we are primarily concerned with the monovalent ions. In addition we are primarily concerned with the relative *number* of the different ions since the ions match each other numerically rather than on a weight basis. For this reason, there has arisen the custom of expressing electrolyte concentrations in terms of milliequivalents rather than milligrams.

The milliequivalent weight (meq. wt.) of an ion is simply the atomic or formula weight (in mg.) divided by the valence.

$$\text{Meq. wt.} = \frac{\text{atomic wt. (mg.)}}{\text{valence}} \quad 1$$

The molecular weight of NaCl (58.5) is obtained by adding together the atomic weight of Na+ (23) and the atomic weight of Cl− (35.5). Hence:

1 meq. NaCl = 58.5 mg.
1 meq. Na+ = 23 mg.
1 meq. Cl− = 35.5 mg.

From this it follows that since one sodium ion exactly matches one chloride ion, 23 mg. of sodium will exactly match 35.5 mg. of chloride. In general, one milliequivalent of any cation will match or combine with one milliequivalent of any anion.

Blood plasma normally contains:

326 mg. Na+ per 100 ml. (3260 mg. per liter);
366 mg. Cl− per 100 ml. (3660 mg. per liter).

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Dividing by the meq. weights we obtain:

142 meq./L of Na+

103 meq./L of Cl−.

The general formula is:

$$\frac{\text{mg\% x 10}}{\text{meq. wt.}} = \text{meq./L} \quad (2)$$

We see that on a weight basis there is more chloride than sodium while on an equivalent basis there is enough sodium to match all the chloride and 39 meq./L left over to be matched by bicarbonate or other ion.

This illustrates the great advantage of reporting electrolytes in milliequivalent units. It shows at a glance, and without further mental gymnastics, the exact numerical relationship among the ions. The situation is further illustrated by comparison with a large high-school dance where the hostess is interested in having approximately the same number of girls and boys present. If the only data she has are that there are 15,000 lbs. of boys and 10,000 lbs. of girls, she would be at a loss to estimate the excess of either sex. On the other hand, if she knows the average weight of the boys is 150 lbs. and the average weight of the girls is 100 lbs., she could readily calculate that there are 100 boys and 100 girls. Of course, you can count boys and girls directly. With ions in solution, however, the concentration must normally be determined in weight units and divided by the known average weight of the ion to give the equivalent units.

Non-electrolytes, such as glucose or urea, do not dissociate into ions and are not concerned with matching or neutralizing other ions so that their concentrations are just as conveniently left in weight units.

The bicarbonate ion (HCO_3-) deserves special mention. Its concentration in plasma is usually determined by addition of acid to release carbon dioxide gas, the volume of which is then measured in the Van Slyke apparatus.

$$HCO_3- + HCl \longrightarrow H_2O + Cl- + CO_2 \quad (3)$$

The custom has arisen, therefore, of reporting the volume of CO_2 obtained from 100 volumes of plasma (volumes %). Since one meq. of HCO_3- liberates one millimole of CO_2, and since one millimole of CO_2 occupies 22.2 c.c. under standard conditions,

$$\frac{\text{vols. \% x 10}}{22.2} = \text{meq./L} \quad (4)$$

The actual analysis for CO_2 includes not only that derived from HCO_3- but also that present as carbonic acid (H_2CO_3) and as CO_2 gas dissolved in the solution. However, since about 95% of the total CO_2 does come from the HCO_3-, it is sufficient for all practical clinical purposes to use the terms "CO_2" and "bicarbonate" interchangeably.

It seems desirable at this point also to say a word about the determination of chloride. The earlier systems of blood analysis were commonly applied to whole blood rather than to just plasma or serum. While whole blood is satisfactory for some analyses, it is not at all suitable for determinations of electrolytes. In the case of chloride, for example, the concentration in the red cell is only half that in the plasma. It is easy to see, therefore, that the "normal" value for whole blood chloride will vary depending on the hematocrit. For this reason, chloride determinations should always be done on plasma or serum.

Sometimes the chloride is determined and expressed as "NaCl" rather than just "Cl". This practice is inaccurate and misleading for actually only the chloride is determined, not sodium chloride, and the determination gives no indication whatever as to the concentration of sodium present. The practice of reporting "whole blood NaCl" should be dropped in favor of the term "plasma chloride".

Electrolyte Patterns of the Body Fluids

Normally, about 70% of the total body weight is water. Since the electrolyte composition of intracellular fluid is so much different from the extracellular it is necessary to consider the two compartments separately. The extracellular compartment is further divided into the vascular (blood plasma) and interstitial fluids primarily because of the greater ease of sampling the vascular compartment. The classification with corresponding approximate volumes is as follows:

Compartment	*Per Cent of Total Body Weight*
Intracellular	50
Extracellular	20
Interstitial	15
Vascular	5

Table 1. ELECTROLYTE COMPOSITION OF BODY FLUIDS

	Vascular meq/L of plasma	*Interstitial* meq/L of fluid	*Intracellular* meq/L of water
Na+	142	145	10
K+	5	4	150
Ca++	5	2.5	
Mg++	3	2	40
Cl−	103	114	0–3
HCO_3-	27	30	10
Phosphate	2	2	150
Sulfate	1	1	
Organic Acids	2	2	
Protein	16	1	30

Adapted from Bodansky[7]

The electrolyte concentrations of the three compartments are shown in Table 1. Plasma is used as

the basis for comparison. It is to be noted that the interstitial fluid is very similar to plasma in composition with the exception that most of the protein has been replaced by chloride. Whereas the extracellular fluid electrolytes are principally sodium and chloride, the intracellular electrolytes are principally potassium and phosphate. The exact mechanism by which this sharp differential is maintained is not clear since it has been shown that sodium and potassium are capable of diffusing readily across the cell membrane. It seems probable that a state of "dynamic equilibrium" is maintained by the active metabolic processes occurring in the living cell which require the presence of potassium and phosphate. It is known, for example, that administration of insulin results in a shift of potassium from the extracellular to the intracellular phase concurrent with the increased metabolism of glucose. The extracellular fluid appears to act only as a suspending medium for the living cell, comparable to the sea water environment for single celled aquatic animals.

Because of the difficulty of analyzing cellular fluid directly, it is necessary to infer the state of affairs from measurements of the extracellular fluid. For example, a low plasma potassium probably indicates an intracellular potassium deficiency; a low plasma sodium indicates a low total base with probable hypotonicity of the intracellular fluid; a state of acidosis or alkalosis, as shown by plasma analysis, is assumed to apply to the intracellular fluid as well. The discussion which follows, therefore, will be based on the normal electrolyte pattern of the plasma; the reasons for variation from normal; and the measures taken to restore the pattern to normal.

Acidosis and Alkalosis

The fundamental theory of acid-base chemistry of the blood is well presented elsewhere.[4, 5] Unfortunately, complete, detailed descriptions of the fundamentals often bewilder the reader with their presentation of buffer systems, pH, logarithmic functions and complicated diagrams with areas of acidosis and alkalosis (metabolic and respiratory, compensated and uncompensated). While the digestion and assimilation of all this material may prove a source of inner satisfaction, one is often led to wonder if the field has not been overly invaded by the mathematically inclined. The present discussion will represent an attempted explanation of the subject in terms of the equilibrium:

$$\underset{\text{carbon dioxide gas}}{CO_2} + H_2O \rightleftharpoons \underset{\text{carbonic acid}}{H_2CO_3} \rightleftharpoons \underset{\text{hydrogen ion}}{H^+} + \underset{\text{bicarbonate ion}}{HCO_3^-} \qquad (5)$$

This equilibrium in the blood may be shifted in either direction depending upon the relative concentrations of CO_2 and hydrogen ion. Considering the equilibrium on the right side only, we may write:

$$[H+] = k \frac{[H_2CO_3]}{[HCO_3-]} \qquad (6)$$

where k is a proportionality constant. This equation demonstrates that the hydrogen ion concentration is dependent only upon the *ratio* of carbonic acid to bicarbonate ion and not upon their absolute amounts. If the concentration of hydrogen ion is high, there is a state of acidosis (low pH); if the concentration of hydrogen ion is low, there is a state of alkalosis (high pH). A condition of acidosis or alkalosis, then, is related directly to the pH, not to the total CO_2 content. On the other hand, since it is technically difficult to measure the pH of the blood and relatively easy to measure the CO_2 content, it is customary to measure the latter and to infer from it and the clinical history the type and degree of acidosis and alkalosis.

The CO_2 equilibrium will be used to illustrate changes occurring in four fundamental types of disturbance. In respiratory acidosis or alkalosis there is a *primary* excess or deficit of CO_2 in the alveolar air. In metabolic acidosis or alkalosis there is a *primary* excess or deficit of hydrogen ion in the blood. Metabolic disturbances are by far the more common. Compensatory changes occur in each type and if the changes are sufficient to maintain the blood pH within normal limits, we say that there is a compensated acidosis or alkalosis. In these compensated conditions the CO_2 content may still be abnormal; the blood pH alone is not sufficient to detect a compensated state of acidosis or alkalosis.

Metabolic Alkalosis: — This condition could be brought about either by loss of acid or retention of base. Loss of the gastric contents, for example, by vomiting or indwelling Levine tube, results in loss of hydrogen ion, higher pH and alkalosis. The immediate compensation is the retention of CO_2 by the lungs resulting in an increase in H_2CO_3 and consequently an increase of the total CO_2 content. The clinical history will indicate that the alkalosis is metabolic; the total CO_2 content of the plasma will indicate its severity; a pH determination would not be needed.

Ingestion of sodium bicarbonate supplies excess bicarbonate ion which would tend to shift the equilibrium to the left. Again, this would result in a decrease of hydrogen ion, higher pH and alkalosis and again this condition is compensated by increased retention of CO_2 by the lungs (hypoventilation). In either case, there is further compensation by the kidney which excretes alkaline urine in an effort to restore the equilibrium.

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Metabolic Acidosis: — This condition could be brought about either by loss of base or retention of acid. Loss of the alkaline contents of the lower intestinal tract through diarrhea would shift the equilibrium to the right with resultant increase in hydrogen ion, lower pH, and acidosis. The immediate compensation is the release of CO_2 by the lungs (hyperventilation) to shift the equilibrium back to the left, thus tending to decrease H+. This results in a decrease of the total CO_2 content. The clinical history will indicate that the acidosis is metabolic; the CO_2 content of the plasma will indicate its severity; a pH determination would not be needed.

Retention of acid occurs in uncontrolled diabetes (ketone bodies) and in kidney failure (lack of excretion of acid waste products, phosphates, sulfates). There is a resultant increase in hydrogen ion, lower pH and acidosis. Here again hyperventilation will decrease the CO_2 content of the alveolar air in an effort to return the equilibrium to normal. As in the preceding case the clinical history and plasma CO_2 content is sufficient to indicate the existence and severity of the metabolic acidosis. In either case the kidney will also compensate, if possible, by excreting a more acid urine in an effort to restore the equilibrium.

Respiratory Alkalosis: — This condition is brought about by hyperventilation (in excess of that required for any compensatory mechanisms. See Table 2). The CO_2 content of the alveolar air is decreased below normal, the equilibrium shifts to the left with resultant decrease in hydrogen ion, a higher pH, and alkalosis. The total CO_2 content of the plasma is lowered. Compensation is through the kidneys which act to excrete a more alkaline urine to relieve the alkalosis. There is also increased retention of chlorides to replace the lowered bicarbonate.

Sometimes it is difficult to decide whether the plasma CO_2 content is low as a result of a metabolic acidosis or a respiratory alkalosis. In such cases, it is necessary to know the blood pH to establish the case. Lacking this, the pH of the urine will usually serve as a guide as to whether a state of acidosis or alkalosis exists. In any event, it is very desirable to establish the correct diagnosis, for administration of alkali to a patient with a low CO_2 from respiratory alkalosis would only aggravate the situation.

Respiratory Acidosis:—This condition is brought about by excess retention of CO_2 by the lungs (in excess of that required for any compensatory mechanism. See Table 2). The CO_2 content of the alveolar air is increased above normal, the equilibrium shifts to the right with resultant increase in hydrogen ion, a lower pH, and acidosis. The total CO_2 content of the plasma is increased. Compensation is through the kidneys which act to excrete a more acid urine to relieve the acidosis.

Table 2. ACIDOSIS AND ALKALOSIS

	pH	*CO_2*	*Condition*
		ACIDOSIS	
Metabolic	Low	Low	Retention of acid or loss of base (1)
Respiratory	Low	High	Retention of CO_2 (2)
		ALKALOSIS	
Metabolic	High	High	Retention of base or loss of acid (3)
Respiratory	High	Low	Loss of CO_2 (4)

1) Diabetes, dehydration, starvation, kidney failure, ingestion of acids, diarrhea, toxemias of pregnancy.

2) Rebreathing, asphyxia, morphine narcosis, bronchopneumonia, pulmonary emphysema, cardiac decompensation.

3) Vomiting, ingestion of alkali, loss of gastric contents.

4) Hyperventilation (hysteria, fever, high altitude, high temperature, encephalitis).

A number of conditions may interfere with normal elimination of CO_2 from the lungs (bronchopneumonia, pulmonary emphysema, morphine narcosis, etc.). Sometimes it is difficult to decide whether the plasma CO_2 content is high as a result of a metabolic alkalosis or a respiratory acidosis. In such cases, a blood pH determination will permit a decision. Lacking this, the pH of the urine will usually serve as a guide as to whether a state of acidosis or alkalosis exists.

CO_2 Content and CO_2 Combining Power:—A measurement of the CO_2 content of the plasma includes all forms of carbon dioxide (dissolved CO_2 gas, carbonic acid, and bicarbonate ion). As mentioned previously, however, about 95% of this total amount represents bicarbonate. If blood is drawn without exposure to air (i.e., under oil) and analyzed for carbon dioxide, we say that we have measured the total CO_2 *content* because the oil has prevented the escape of carbon dioxide gas and has maintained the normal equilibrium of the carbon dioxide system. The CO_2 content shows the state of affairs as they actually exist in the patient's blood. On the other hand, if blood is drawn and exposed to the atmosphere, CO_2 gas will diffuse out of the sample, the equilibrium will shift to the left and the CO_2 content will gradually decrease. Some laboratories still follow the practice of "re- equilibrating" this plasma. By this method, the laboratory technician passes expired air from her own lungs over

and through the sample of plasma on the assumption that the CO_2 content of her alveolar air is the same as that of the patient. After this equilibration, the CO_2 content of the plasma is determined in the usual way (equation 3) except that it is now called the "CO_2 combining power" or "alkali reserve". *If* the alveolar CO_2 is the same in both the patient and technician, the CO_2 content and CO_2 combining power will give about the same answer. In uncomplicated cases of metabolic acidosis or alkalosis the alveolar CO_2 is approximately normal so that the CO_2 combining power will provide the needed information. In all types of respiratory alkalosis or acidosis, however, the CO_2 combining power will give false results. In addition, the extra manipulations involved in re-equilibrating may introduce appreciable error. For these reasons, it is strongly recommended that determinations of CO_2 combining power be discarded and replaced by determinations of CO_2 content on samples of blood which have been placed under a thin layer of mineral oil immediately after being drawn.

Determinations of blood pH should always be interpreted in conjunction with determinations of CO_2 content, not CO_2 combining power. Table 2 summarizes the four conditions represented by the four possible combinations of pH and CO_2 content.

Abnormal Electrolyte Patterns

The preceding discussion on acidosis and alkalosis was concerned primarily with changes in the bicarbonate content of the plasma. In addition to these changes, or concurrently with them, there occur changes in the concentration of other plasma electrolytes which are highly significant and which point the way towards proper therapy. The normal electrolyte composition of the plasma, shown in Table 1, can be represented diagrammatically by two adjacent columns of equal height, one for the sum of the cations and the other for the sum of the anions. The columns are subdivided to show the relative concentrations of each ion. Such a diagram, as popularized by Gamble,[1] is very convenient for illustrating the changes which occur in the plasma electrolytes under various conditions.

It is very important to emphasize that these values represent *concentrations* of electrolytes, not total amounts. By excessive sweating, for example, a person may become dehydrated to the extent that his serum sodium will show an increase in concentration whereas the total body stores have actually been decreased. The interpretation of electrolyte concentrations, therefore, must always be made with reference to the *degree of hydration* of the patient.

Table 3. NORMAL ELECTROLYTE PATTERN OF BLOOD PLASMA

CATIONS	*Meq/L*	*ANIONS*	*Meq/L*
Sodium	142	Bicarbonate	27
Potassium	5	Chloride	103
Calcium	5	Phosphate	2
Magnesium	3	Sulfate	1
		Organic acids	6
Total	155	Protein	16
		Total	155

Table 3 shows the normal electrolyte pattern of the plasma. It is to be noted that there are 155 meq. of cations ($Na^+ + K^+ + Ca^{++} + Mg^{++}$) matched by an equal number of anions ($HCO_3^- + Cl^- +$ phosphate + sulfate + protein, etc.). The sum of all the cations (155) is often referred to as the "total base". Since the total base is made up for the most part of sodium, either value may be determined; that is, the total base will enable the estimation of the sodium or the sodium will enable the estimation of the total base. With the widespread use of the flame photometer, it is becoming more common to think in terms of sodium ion concentrations. If neither determination is available, it is possible to estimate the sodium roughly by adding ten to the sum of the chloride and bicarbonate ion values.

Normal Cl^- + normal HCO_3^- +10=normal Na^+
103 + 27 +10= 140

The figure "10" must be increased if there are ketone bodies present (diabetes) or phosphate retention (nephritis). Since these conditions are usually associated with electrolyte imbalance, it becomes of importance to have sodium determinations available rather than rely on an empirical formula.

Table 4. PATHOLOGICAL CHANGES IN PLASMA ELECTROLYTES
SODIUM

Increased: Dehydration due to
1. Water deprivation
2. Diabetes
3. Sweating

Decreased: Without edema
1. Addison's disease
2. Salt losing nephritis
3. Diarrhea
4. Loss of bile (T-tube drainage)

Decreased: With edema
1. Anuria, with excessive salt-free fluids, (lower nephron nephrosis)
2. Low salt syndrome

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CHLORIDE AND CO_2

Chloride decreased; CO_2 increased:

1. Vomiting
2. Potassium deficiency alkalosis
3. Primary CO_2 retention (emphysema)

Chloride unchanged or decreased; CO_2 decreased:

1. Ketosis
2. Renal insufficiency (phosphate retention)

Chloride increased; CO_2 decreased:

1. Renal disease with excess saline therapy
2. Nephrosis with ammonium chloride therapy
3. Primary CO_2 deficit (hyperventilation)

POTASSIUM

Increased:

1. Chronic renal insufficiency
2. Diabetic acidosis (*before* insulin therapy)
3. Adrenal cortical insufficiency (Addison's)

Decreased:

1. Starvation
2. Hyperadrenal cortical activity
3. Diabetic acidosis (*after* insulin therapy)
4. Infant diarrhea
5. Familial periodic paralysis

Adapted from Squires and Elkinton[13]

For reference, there is shown in Table 4 a summary of the pathological conditions associated with increases or decreases in the major electrolyte components of the extra-cellular fluid. Some representative changes in the electrolyte pattern will be discussed briefly with reference to Table 5. On the

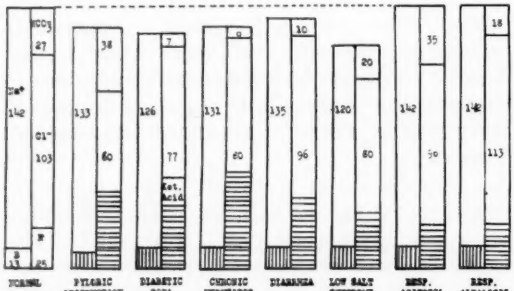

Table 5. Abnormal Patterns in Plasma Electrolytes. Values shown are representative of fairly acute stages.

cation side, the compartment for sodium is marked. The remainder (B) is composed of potassium, calcium and magnesium. On the anion side, the compartments for CO_2 and Cl− are marked. The remainder (R) is composed of sulfate, phosphate, organic acids and protein.

a. *Pyloric Obstruction:*—The pattern is typical of a loss of gastric contents (by vomiting or suction drainage). There is a loss of chlorides with compensatory increase in bicarbonate. Sodium is also decreased due to excretion of $NaHCO_3$ by the kidneys.

Such cases usually respond well to isotonic saline. More severe cases may require ammonium chloride therapy. The ammonium ion is converted to urea by the liver so that only the chloride ion is left to affect the electrolyte structure. Since the primary loss of gastric contents represents a loss of hydrochloric acid, it would seem logical to replace the deficit by intravenous administration of hydrochloric acid and indeed this has proved successful in very severe cases of alkalosis. In general, such heroic measures are unnecessary.

b. *Diabetic Acidosis:*—Accumulation of ketone bodies on the anion side results in a decrease in the bicarbonate compartment. Normally, sodium is conserved by the kidneys which manufacture ammonia to combine with acid radicals for excretion in the urine. The great excess of ketone bodies present in the blood in diabetes overtaxes the capacity of the kidneys so that sodium is also lost in the urine in large amounts. This decrease in the sodium level of the blood results in a second decrease in bicarbonate in addition to that already imposed by the presence of ketone acids on the anion side. The resultant acidosis may become very severe. Insulin will improve glucose metabolism and effect removal of ketone bodies. Normal saline is indicated to correct dehydration while either sodium lactate or sodium bicarbonate may be necessary to correct more severe cases of acidosis.

It is of interest to note that with impaired metabolism of glucose and loss of sodium from the extracellular compartment, potassium migrates out of the cells and is also excreted in considerable quantities. Following treatment, potassium moves back into the cells to such an extent that the plasma concentration may reach dangerously low levels. As we shall see later, small amounts of potassium chloride may be given advantageously following an episode of severe diabetic acidosis.

c. *Chronic Nephritis:*—Conditions vary somewhat but the typical picture is one of moderate acidosis. Retention of phosphate, sulfate and organic acids on the anion side cause a corresponding reduction in bicarbonate. The failure of the kidney to remove these acid radicals properly is often further complicated by its inability to conserve sodium through manufacture of ammonium ion. Consequent reduction in plasma sodium levels causes further reduction in bicarbonate. Patients in renal failure present one of the greatest problems in parenteral fluid therapy. The electrolyte pattern presented here is best corrected by judicious administration of normal saline and sodium bicarbonate (or sodium lactate).

This pattern is typical of the so called "salt-losing nephritis" in which there is a low level of plasma

sodium. On the other hand, bicarbonate or lactate should *not* be given if there is edema for the sodium ion will simply move into and increase the volume of the edema fluid. Edema is more readily relieved by administration of some acid salt, such as ammonium chloride, or by hypertonic solutions.

Another complication introduced in nephritis is the danger of decreasing the level of ionized calcium to the point of tetany. Phosphate ion, accumulating in the blood, combines with calcium ion to form non-ionized calcium phosphate. Rendering the blood too alkaline with sodium bicarbonate or sodium lactate will cause more calcium to be bound up as phosphate. It is evident, therefore, that administration of alkali to the nephritic should be attempted with caution.

d. *Diarrhea:*—As shown in Table 7, intestinal secretions contain relatively more sodium than chloride. Extensive loss of these secretions by severe diarrhea results in a selective lowering of sodium and bicarbonate. The acidosis produced is made still more acute by the state of dehydration produced. With dehydration there is an increase in the concentration of plasma proteins which puts a second squeeze on the bicarbonate compartment. It does seem unfortunate that in nearly all types of metabolic acidosis, the bicarbonate is hit from both sides.

The infant, with his more delicate response to electrolyte imbalance, is especially apt to present a problem of this type. Since there is also a considerable loss of potassium in diarrhea, Darrow's solution is frequently used in parenteral fluid therapy. This solution contains sodium chloride, sodium lactate, and potassium chloride. The danger inherent in producing a high plasma concentration of potassium makes it imperative that this solution be administered slowly (not more than 10 ml. per minute).

e. *Low Salt Syndrome:*—This condition may occur after a prolonged low salt diet in the presence of cardiac failure. Both sodium and chloride are decreased proportionately so that the CO_2 content often remains essentially normal. Since the low sodium indicates hypotonicity of extracellular fluid, it follows that the intracellular fluid is likewise hypotonic. Administration of hypertonic saline is indicated for supportive therapy to relieve edema.

f. *Respiratory Acidosis:*—This condition may be caused by chronic emphysema or other conditions as shown in Table 2. The increased CO_2 content with decreased chloride values present a picture which closely resembles a metabolic alkalosis. Of course, it would be undesirable to treat such a patient on the latter assumption for it would only aggravate the existing acidosis.

g. *Respiratory Alkalosis:*—Here we have an alkalosis produced by hyperventilation with decreased CO_2 content and a compensatory rise in chloride. The rise in plasma chloride concentration helps to distinguish this condition from metabolic acidosis. Acidosis or alkalosis of the respiratory type are rarely severe enough to present a problem requiring parenteral fluid therapy. They may frequently present a problem in diagnosis and it is here that a blood pH determination will be of value.

Parenteral Fluid Therapy

Interpretation of Laboratory Values

Owing to the vast difference in electrolyte composition between the plasma and the red cells, it is most important that blood samples be taken without hemolysis and that the serum be separated from the cells as soon as practicable. If sodium or potassium determinations are required it is, of course, not possible to use such anticoagulants as potassium oxalate, sodium citrate, or sodium fluoride. In general, it is more convenient to perform analyses on serum.

It should also be pointed out that blood samples taken at the same time that the patient is receiving fluids intravenously are apt to show results which can be very misleading. The only excuse for mentioning this obvious fallacy is that misinterpretations do arise for this reason.

Laboratory values for the plasma electrolytes provide a quantitative estimation of the *degree* of acidosis or alkalosis, and the *extent* of electrolyte imbalance. For this reason the laboratory values will be of considerable help in estimating the type and quantity of repair solutions to be administered. On the other hand, the primary considerations will obviously revolve about the clinical history and condition of the patient. What type and quantity of fluid has been lost prior to examination (vomiting, diarrhea, sweating, etc.)? Is there any indication of liver dysfunction? Kidney dysfunction? Cardiac failure? Is the patient edematous? Dehydrated? All these factors must be considered and the contraindications clearly visualized before any regimen of fluid therapy is chosen.

Water Requirements

Gamble[1,2] has studied the water requirements of humans rather extensively and has emphasized repeatedly that the first goal of fluid therapy is to correct any existing state of dehydration and to supply sufficient *water* to cover the daily obligatory requirements. These requirements are optimally met in the average adult by supplying 2000 ml. of 5% dextrose in water. The dextrose has the happy effect of conserving both body protein and body sodium; consequently, a big step toward correcting any electrolyte imbalance has already been taken by

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supplying dextrose solution alone. The practice of giving dextrose in saline solution is not recommended since this supplies no water to cover obligatory expenditures. In other words, some water must be made available to the kidneys for the normal daily excretion of waste products and this water cannot readily be drawn from isotonic saline without further dehydrating the patient.

The daily requirements for infants are relatively higher than for adults. For those who are quantitatively minded, the daily water requirement for adults figures out to be about 30 ml. per kilo while the requirement for infants is about 80 ml. per kilo. This presents a good starting figure to work with but of course the requirements may be much greater if there is excessive fluid loss. Table 6 shows the approximate daily water balance of an adult and the possible increases in water loss as a result of excessive sweating, vomiting or diarrhea.

Table 6. WATER EXCHANGE IN ADULT HUMAN

Fluid Intake	
Water drunk	1200 ml.
Water from food	1000 ml.
Water of oxidation	300 ml.
	2500
Fluid Excreted	
Water vaporized	1200 ml.
Water of urine	1200 ml.
Water of stool	100 ml.
	2500
Pathological Water Loss	
Hyperventilation	1– 2 liters
Excessive sweating	10–15 liters
Vomiting	Up to 5 liters
Diarrhea	Up to 5 liters

Electrolyte Requirements

Normal saline (0.85% NaCl) is no doubt the most widely used solution for electrolyte therapy. This is logical as well as practical since the major extracellular fluid electrolyte is sodium chloride. For more severe cases of alkalosis, one thinks of ammonium chloride or even hydrochloric acid. For more severe cases of acidosis, either sodium bicarbonate or sodium lactate comes to mind. If total base is markedly decreased (low sodium), hypertonic saline may be indicated. The effectiveness of ammonium chloride or sodium lactate in electrolyte therapy depends upon the integrity of the liver to metabolize ammonium and lactate ions; consequently, these substances are contraindicated in the presence of liver damage. Finally, the administration of potassium should be undertaken with particular caution since a high concentration of potassium in the plasma may produce a heart block.

On the quantitative side we are faced with the dual problem of maintenance and repair. By maintenance is meant the supply of water and electrolytes to cover the daily losses; by repair is meant the supply necessary to restore water and electrolyte balance to normal. For maximum efficiency in handling such problems it is advisable to prepare a balance sheet showing the total daily fluid intake and output. Since a part of the output consists of "insensible" loss due to perspiration and respiration it must be estimated on the basis that a normal adult loses about 1200 ml. of water per day by this route.

Rough estimates of the chloride content of the urine or other fluids obtained by drainage should also go on the balance sheet to permit an estimate of replacement requirements. The Fantus test[19] provides a semi-quantitative test for the estimation of the chloride content of urine. To 10 drops of urine in a test tube is added 1 drop of 20% potassium chromate as indicator followed by silver nitrate (2.9% solution) drop by drop until a permanent and distinct change in color from yellow to red-brown takes place. The number of drops of silver nitrate required to cause the color change will be equal to the number of grams of sodium chloride present per liter of urine. Table 7 shows the approximate electrolyte composition of various body secretions.

Table 7. AVERAGE ELECTROLYTE COMPOSITION OF BODY SECRETIONS

	Milliequivalents per Liter			
	$Na+$	$K+$	$Cl-$	HCO_3-
Plasma	142	5	103	27
Spinal Fluid	147	2.8	125	21
Gastric Juice	20	8	145	0
Bile	140	8	108	38
Pancreatic Juice	140	5	40	110
Jejunal Juice	138	5	110	30
Sweat	82	5	85	0

Adapted from Darrow[17]

When one considers the uncertainty of estimating insensible water loss and shifts of water and electrolytes which can and do occur between the extracellular and intracellular fluid compartments, it is apparent that nothing is to be gained in keeping balance sheet records down to the last ml. of water and the last milligram of chloride. Fortunately, except in complete anuria, the kidney is able to select its requirements from the fluids available much more wisely than we are able to present them.

Table 8 shows the electrolyte composition of some fluids commonly given parenterally. Many others have been proposed which are more balanced,

Table 8. COMPOSITION OF FLUIDS FOR PARENTERAL THERAPY

Solution	*Milliequivalents per Liter* Na+	Cl−	K+	Lactate
0.85% NaCl (normal saline)	145	145	—	—
5% NaCl	855	855	—	—
M/6 Sodium Lactate	167	—	—	167
2% Ammonium Chloride	—	374	—	—
"3-2-1" Solution 3 L. 5% Dextrose 2 L. 0.85% NaCl 1 L. M/6 Na Lactate	81	48	—	33
Darrow's Solution NaCl 3 gm. KCl 2 gm. M/1 Na Lactate 40 ml. Water 710 ml.	122	104	35	53
Mixed Chlorides Solution NaCl 8.5 gm. NH_4Cl 8.5 gm. KCl 2.0 gm. H_2O 1 Liter	145	331	27	—

Ampoules Available

Sodium Bicarbonate	50 ml.	3.75 grams	45 meq.
Sodium Lactate	40 ml.	4.50 grams	40 meq.
Potassium Chloride	10 ml.	1.49 grams	20 meq.

Equivalent Values

1 gram of :	NaCl	= 17 meq.
	KCl	= 13 meq.
	NH_4Cl	= 19 meq.
	$NaHCO_3$	= 12 meq.
	Na Lactate	= 9 meq.

that is, contain small amounts of calcium chloride and potassium phosphate to compensate for loss of these substances. The latter solutions may become increasingly valuable if the patient must be kept on parenteral therapy for extended periods of time.

It is possible, from the laboratory values and the weight of the patient, to arrive at some estimate of the total body deficit of a given electrolyte and hence an estimate of the quantity of solution required to correct the deficit. In cases of acidosis, or alkalosis or low salt syndrome, the total body water is used as the basis for calculation since the acidosis, alkalosis, or hypotonicity will apply to the intracellular as well as the extracellular phase.

Table 9 shows the calculation for a typical case of metabolic acidosis treated with sodium lactate. The number of liters of body water multiplied by

Table 9. CORRECTION OF ACIDOSIS

Observed CO_2 = 10 meq/L
Normal CO_2 = 27 meq/L
Deficit of CO_2 = 17 meq/L
Body weight = 50 kg.

Total body water = 50 x 0.70 = 35 kg. or 35 liters.
35 x 17 = 595 meq. CO_2. Total body deficit.
M/6 Sodium Lactate contains 167 meq/L.

$$\frac{595}{167} = 3.6 \text{ liters, total requirement.}$$

the deficit of CO_2 in meq./L gives the total body deficit of CO_2 in terms of milliequivalents. Dividing this by the number of meq. in one liter of 1/6 molar sodium lactate gives the number of liters of lactate required. Note that the estimation is based on the CO_2 values, not the chloride.

Another way to approach the problem is to calculate the volume of 1/6 molar sodium lactate required per kilo of body weight to raise the CO_2 content one milliequivalent per liter. Thus, each kilo of body weight contains 0.7 liter of water. If the deficit is one meq./L, each kilo of body weight represents a deficit of 0.7 meq. of CO_2. One ml. of 1/6 molar sodium lactate will supply 0.167 meq. of CO_2; therefore, a deficit of 0.7 meq. will require 0.7/0.167 or 4.2 ml. of sodium lactate per kilo. From this it follows that 1/6 molar sodium lactate, at 4.2 ml. per kilo of body weight, will raise the CO_2 content one meq./L. Using the same example as in Table 9:

$4.2 \times 50 \times 17 = 3600$ ml. or 3.6 liters of 1/6 molar sodium lactate.

In a similar manner factors may be worked out for various solutions or solid salts. These factors are tabulated in Table 10. The factors presented for sodium chloride and normal saline have been calculated from data presented by Maddock[6] and are not based on the total body water. It is strongly emphasized that such factors will provide only an *approximate* estimate of the *total* body deficit. Contraindications must always be kept in mind. In addition, the entire deficit should *not* be corrected all at once. It is much better in severe cases to effect a gradual return to normal. There is always the danger of overshooting the mark if electrolyte therapy is pressed too vigorously.

Table 10. FACTORS FOR ESTIMATION OF ELECTROLYTE REQUIREMENTS

	per kilo of B. Wt.			*meq/L*
M/6 Sodium Lactate	4.2	ml.	raises	CO_2 1
Sodium Bicarbonate	0.058	gm.	raises	CO_2 1
2% Ammonium Chloride	1.9	ml.	lowers	CO_2 1
Ammonium Chloride	0.037	gm.	lowers	CO_2 1
Sodium Chloride	0.020	gm.	raises	Cl− 1
0.85% NaCl	2.3	ml.	raises	Cl− 1
5% NaCl	0.82	ml.	raises	Na+ 1

continued on next page

Potassium Chloride:

Postacidotic phase of diabetes, 30 to 60 meq. (2 to 4 gm. KCl).

Postoperative potassium deficiencies, 50 to 100 meq. (4 to 8 gm. KCl) daily for several days until serum level returns to normal.

Marked dehydration: About 70 ml. normal saline per kilo of body weight.

Caution! The above factors must not be used indiscriminantly. See text for contraindications. Do not attempt to correct an electrolyte imbalance too rapidly.

Potassium

Table 10 also lists the maximum daily quantities of potassium chloride recommended for potassium deficiencies.[7] Because of the intracellular nature of potassium and the danger inherent from high concentrations of potassium in the extracellular fluid, potassium therapy should be closely correlated with serum potassium and electrocardiographic changes. The electrocardiogram is usually, but not always, a reliable means for revealing the presence of a low serum potassium. Sudden administration of potassium chloride intravenously can precipitate intraventricular block and ventricular fibrillation with eventual cardiac arrest in diastole.

Table 11. ELECTROLYTE COMPOSITION OF AVERAGE NORMAL URINE

	gm./24 hrs.	*meq/L*
Water	1200	—
Sodium	4.0	145
Potassium	2.0	43
Calcium	0.2	8
Magnesium	0.15	10
Ammonia	0.7	34
Chloride	7.3	171
Phosphate (as P)	1.1	30
Sulfate (as S)	0.8	42

Adapted from Hawk, Oser and Summerson[20]

The total deficit of body potassium cannot be calculated readily; hence the necessity for empiricism. Many postoperative potassium deficiencies develop because potassium is lost (through the urine or other body fluids) and is not replaced. Fortunately, when the patient is able to take food by mouth, adequate intake is probable. With prolonged maintenance on parenteral therapy, a possible potassium deficiency should be considered and corrected.

In general, any program of electrolyte and fluid therapy should be conducted on the basis of frequent examinations which include:

1) clinical examination of the patient
2) determination of the urine volume, specific gravity and pH
3) serum chloride and CO_2 content
4) serum sodium and potassium if possible.

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PROVIDENCE MEDICAL ASSOCIATION

Next Meeting: Monday, November 3

Medical Library . . . 8:30 p.m.

ADMINISTRATIVE PROBLEMS IN AIR POLLUTION CONTROL IN PROVIDENCE*

AUSTIN C. DALEY

The Author. *Austin C. Daley, Air Pollution Engineer, City of Providence, R. I.*

THERE IS no support more sought after by air pollution regulation officials than that of the medical profession, and no medical group has worked harder to help control air pollution than the Providence Medical Association. This organization has never failed to speak out when Providence Air Pollution Division requested its aid. The Providence Medical Association played an important work in the initiation of the city's air pollution regulation program.

With all the effort put forth by the department and all the support given by civic minded organizations, little would have been accomplished without the firm support of the Mayor of Providence, Walter H. Reynolds.

His broad view of the welfare of the citizens, and keen grasp of air pollution conditions led him to encourage the work of the department and strengthen the morale of its personnel to the point where pride in their work is an assurance of their intentions to make the air of their city as clean as is humanly possible.

Providence has made considerable progress in air pollution regulation, and the success attending our efforts has attracted nation wide attention. The Division of Air Pollution Regulation feels that only the surface has been scratched and much hard work is still to be done. A few examples will serve to show the problems that have been solved and the difficulties remain to be conquered.

Most of the pioneering work in air pollution regulation was done in England and laws were passed there against smoke pollution as early as the turn of the fourteenth century. Just about all of the textbooks on smoke problems were written by Englishmen. As far as we can find there isn't a single book published in America on how to administer an air pollution control system.

Visitors to Britain haven't been overly impressed by the cleanliness of urban atmospheres so, having no successful precedent, we have been forced to devise our own methods. It is indeed unfortunate that, up to the present time, it seems that the wrong people have been drafting rules on air pollution control administration.

The solution of the problem is primarily engineering but few communities start off by procuring the services of a graduate engineer as the enforcing officer. Moreover, this officer cannot turn to dozens of good textbooks which have proved their merits on the subject, such as the many volumes on water supply and sewerage. He has to start from scratch and that is usually when he is badly advised.

For example; one of the big soft coal organizations has its ear to the ground, and when they hear of a community up in arms over smoke, they are quick to rush in to make a free survey and set up a complete program for the city. Naturally they make sure that in no way will soft coal be restricted in this set-up. Very often they recommend an engineer to head the newly formed air pollution department for the city or town. You can well imagine the enthusiasm that his new man will have if it is suggested that rulings of any sort be placed on soft coal.

Smoke is no longer considered the only problem in air pollution. Gases, invisible fumes and dust can cause damage to health and property. In Providence we try to correct anything that makes the air unpleasant. Lately the Manufacturing Chemists' Association has shown an interest in air pollution abatement and this year they published a book entitled "A Rational Approach To Air Pollution Control." The chemical and allied industries are major contributors to the aerial contamination so therefore they, like the coal dealers, are very happy to draw up laws for air pollution control officials to follow. The Manufacturing Chemists' Association's booklet is quite complete in its recommendations for a model air pollution ordinance. For example, it speaks strongly against any licensing or permit system for the air pollution engineer. It recommends allowing plants to install equipment without a permit and then going after the offender if he causes pollution.

We in Providence feel that we have strong arguments against these recommendations. But first let us look at their source. Should these people be telling the communities of America how to run an air pollution program? If they should, why don't we

continued on next page

*Presented at the regular meeting of the Providence Medical Association, at the R. I. Medical Society Library, April 7, 1952.

have race track operators draw up racing laws for the state legislatures? In the same light, shouldn't we let our scrap metal dealers and cafe owners write our city zoning laws?

It is our opinion that, through the pressure of industry, many air pollution officials are being reduced to the role of mere chore boys for certain selfish interests.

After a representative of industry had upbraided us publicly and ridiculed our program here in Providence, he had the effrontery to send us a letter deriding our character and professional ability. While in Providence he, as an engineer, provoked a heated argument on medical matters with the physician representing the Providence Medical Association at our public hearing. The same man has been quoted as stating that air pollution officials are not qualified for their jobs. He said that if they had real ability they would be out in industry making more money. Is this not also a slap at the physicians who remain in the U. S. Public Health Service rather than increase their incomes in private practice? A forest ranger would be subject to scorn and abuse too, because he isn't earning money commensurate with his university degree.

Air pollution control officers are not the only public officials who are receiving strongly worded proposals from the people whom they must police. The Food and Drug Administration is now fighting for a law revision which would give it strict control over the "new ingredients" going into food, the same as the authority it now has over drugs. Specifically the proposal is that no manufacturer shall add any new substance to a food or cosmetic preparation unless he shall first have proved it harmless.

Most nationally known companies are for the proposed law. But one group of manufacturers, gathered together in the Manufacturing Chemists' Association, has countered with another proposal, calling for the manufacturer to give a 60-day notice to FDA of his plan to use a new substance in a food preparation. These manufacturers want to throw the burden of testing and proof on the Government. Is this not analagous to stripping the air pollution officials of their right to read plans and give permits for new construction before the air pollution nuisance is created?

Air pollution engineers are appreciative of the help of industry as to devising technical methods to alleviate the atmospheric contamination it creates. However, industry has no more business telling public officials how to police it than a culprit should dictate to a police force on procedure for apprehending criminals.

We would like to give a few examples of how vital the permit or licensing system is to a good air pollution control system.

In our files we have a printed report of the smoke program in Providence in 1916. The predecessor to our present power utility had stated that their new stoker installations would operate smokelessly. In those days no study was given to potential smoke hazards in granting permits, if any permits were granted at all. Anyone living in Providence knows the results.

At this writing the Narragansett Electric Co. has under construction, at their South Street Station, two giant steam generators capable of producing a combined total of one million pounds of steam per hour. According to the soft coal spokesman air pollution officials have no right to study the blueprints for such a gigantic enterprise. He argues that they are not capable of understanding it.

All of us know that the design of a power plant of such magnitude requires thousands of manhours of dozens of crack engineers, many of whom have spent the greater part of their lives in this highly technical work.

However, we in Providence are studying these prints. We are granting a construction permit after we found that, incorporated in the design of this new plant, are mechanical and electrostatic precipitors in series. We are satisfied that they are equal to the latest and best designed collectors available. In this way we feel that we can give maximum protection for the purity of the air that all of us must breathe.

We believe that no utility would spend the money for such complete dust collecting equipment unless they were "encouraged" by a strong, public-supported air pollution department. The parent company of our local utility recently finished a new power plant in a neighboring state. This plant has only the electrostatic collectors, not the mechanical-electrostatic combination protection which we will enjoy.

In the mid-twenties new generators went in at the Narragansett Electric Company with no collection devices whatsoever. Shortly after the past war their Manchester Street Plant put in only mechanical collectors in their new generators, the performance of which is not always satisfactory in our opinion. Now we have reached the stage where both types of collection devices are installed. Wouldn't it have been advantageous if an air pollution official were checking on new installations a few years ago?

About three years ago the citizens of North Providence took legal action against a bronze foundry whose fumes were annoying them. A year later we were astounded to find that the same company had moved into Providence and located across the street from a grammar school. The teachers were complaining that blue fumes emanating from the foundry were causing the children to cough and were creating an unpleasant condition.

The company installed its fuel burning equipment without a permit and made no provisions for abating the fume nuisance that its bronze melting furnaces would create. It is now well over two years since we first discussed this problem with this offending company's officials and they have done nothing to clean up the condition.

For over a year we pleaded and remonstrated with them and we and the school officials received promises that the nuisance would be rectified. After a year of complete frustration we took initial steps for legal prosecution. We have spent another year on this unpleasant task. Two months ago we were solemnly promised drawings and specifications for corrective devices. These never arrived so we are back in court. Their attorney succeeded in carrying the case past the Superior Court to the Supreme Court. We are hoping for a final decision next month. Meanwhile, the children are back in school, plagued by the fumes for the third straight year.

We like to believe that nothing so disturbing could happen to us under our new set-up. At present our chief inspector scans through all the building permits in the Building Inspector's office every day. This procedure usually takes only about ten minutes because very few new structures are potential air pollution hazards. However, when he comes across one, such as a foundry or refinery, engineers from that concern are invited in and we sit down and discuss the project. A permit is issued only after we are assured that equipment will be installed that will protect the community against air pollution. If we had this system in operation a few years ago, the children in that school would not be coughing with fumes today.

The soft coal organization and the Manufacturing Chemists' Association will not agree with us, but imagine what a nightmare our municipalities would face if buildings went up and were wired without permits. Could any community afford the squads of lawyers and witnesses, spending years in court, for hundreds of cases, to say nothing of the lives that would be lost in the dangerously wired, rabbit hutches that would be built?

In May, 1950, President Truman called the first National Symposium on Air Pollution. Mr. Truman expressed keen interest in the growing problems of impure air and at his direction there was assembled in Washington the greatest gathering of air pollution scientists in history. Medical men, aerologists, engineers and scientists from all over the free world were there. The Secretary of the Interior announced that all the scientific faculties of the U. S. Government would be placed at the disposal of those present. This announcement has been fulfilled. The various agencies in Washington have always been enthusiastically helpful whenever they have been asked for assistance by air pollution control officials. Through the years the U. S. Bureau of Mines has been sending gratuitously literature and the latest design data on particular air pollution problems faced by American communities. Dr. Louis C. McCabe of the Bureau is internationally recognized. He organized and started the giant Los Angeles Air Pollution Control District, but no hamlet is too small to merit his personal attention.

Despite the fine cooperation of these Washington authorities some American communities have their hands full trying to correct smoking federal buildings.

Three years ago we started at Pershing Square and worked towards Olneyville. We visited executives in every plant in this area requesting extra cooperation so as not to sully the air that must be breathed by the patients in the new Veterans' Hospital at Davis Park. We pointed out that some of the patients would have respiratory troubles and we received heart-warming cooperation in every plant. Now we regret to say that the only chronic offender in this area is the VA Hospital! We have made many friendly visits, had pleasant chats and made suggestions at the hospital but we have had no results. Not one remedial suggestion has been carried out.

Last January the VA Hospital in Kansas City, Mo., was creating such a nuisance that the local officials threatened to seal the boiler unless the smoke was abated. Counsel for the hospital wrote to the Kansas City officials to keep out of the boiler room as it was under the exclusive control of the United States of America and that the physical sealing of the boiler will not be tolerated.

Sometimes air pollution problems cannot be overcome because the control officials lack legal weapons. As an example: stand on the Point Street bridge on a windy day and watch the Narragansett Electric Company's coal pile. Pieces of coal can be detected landing half way out in the stream, and fresh, unburned coal dust can be scraped almost daily from the windows of the Fox Point offices and homes.

Fox Point residents state that this condition abates when the coal is covered with snow.

U. S. Bureau of Mines authorities estimate that there is an annual two or three percent wind loss from uncapped coal depending on weather conditions.

Many cities force the owners of coal piles to protect them with asphaltic capping. In one city a giant pile is protected on four sides with a cement concrete wall and the only exposed surface is topped with an asphaltic crust. There is little or no air pollution created by this pile.

In South Providence some housewives are extremely upset by young mountains of volcanic sand

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NOVEMBER 4

WHEN OUR great political parties met in convention this summer and adopted their platforms the actions were given wide publicity. But we wonder now, as election day draws near, how many citizens remember the pledges, promises and predictions enunciated in the lengthy platform reports. If you do not recall what was stated regarding national health insurance here are the two platforms:

Health Insurance Plank
Republican Party Platform

"We recognize that the health of our people as well as their proper medical care cannot be maintained if subject to federal bureaucratic dictation. There should be a just division of responsibility between government, the physician, the voluntary hospital, and voluntary health insurance. *We are opposed to federal compulsory health insurance with its crushing cost, wasteful inefficiency, bureaucratic dead weight, and debased standards of medical care.* We shall support those health activities by government which stimulate the development of adequate hospital services without federal interference in local administration. We favor support of scientific research. We pledge our continuous encouragement of improved methods of assuring health protection."

Health Insurance Plank
Democratic Party Platform

We will continue to work for better health for every American, especially our children. We pledge continued and wholehearted support for the campaign that modern medicine is waging against mental illness, cancer, heart disease and other diseases.

Research: We favor continued and vigorous support, from private and public sources, of research into the causes, prevention and cure of disease.

Medical Education: We advocate federal aid for medical education to help overcome the growing shortages of doctors, nurses, and other trained health personnel.

Hospitals and Health Centers: We pledge continued support for federal aid to hospital construction. We pledge increased federal aid to promote public health through preventive programs and health services, especially in rural areas.

Cost of Medical Care: We also advocate a resolute attack on the heavy financial hazard of serious illness. We recognize that the costs of modern medical care have grown to be prohibitive for many millions of people. We commend President Truman for establishing the non-partisan commission

on the health needs of the nation to seek an acceptable solution of this urgent problem.

Here we have an unqualified declaration against federal compulsory health insurance by the Republican party, and from the Democratic party a less moderate position than the one taken by President Truman, but at the same time no definite indication that compulsory health insurance would be unacceptable. Looking beyond the platforms and to the leaders we find both General Eisenhower and Governor Stevenson expressing themselves as against the socialization of the practice of medicine.

Therefore we can only hope that the American people, having made their selection of the next President, will see to it that he halts the trend towards national socialism quickly and effectively.

FLUID AND ELECTROLYTE CHANGES

Claude Bernard first recognized that the living organism does not really exist in the "milieu exterieur" but rather in the "milieu interieur," consisting of the fluids which bathe the cells, and that stability of the "milieu interieur" is necessary for an independent existence. During the approximately seventy-five years since his time medicine and surgery have seen their greatest advances and have taken their place among the exact sciences. The problems involved with fluid balance in health and disease have during this time received exacting physio-chemical study. Today the physician has not only this data at his disposal but also methods for the rapid and accurate chemical determination of the electrolyte content of the patient's body fluids.

The importance of fluid and electrolyte changes cannot be underestimated. They must be sought for and corrected in almost all instances of serious disease. In the medical field, many diseases such as diabetes, pneumonia, Addison's disease, heart failure and infantile diarrhoea (to mention only a few) have their specific remedies, yet the alterations in fluid and electrolyte balance must be detected and corrected if the patient is to recover; otherwise, in many instances the specific agent will not even have an opportunity to work. Similarly, modern surgery would be well nigh impossible without supportive therapy with electrolyte repair solutions.

Elsewhere in this journal there is an excellent review of the basic physical chemistry necessary to an understanding of the main types of electrolyte imbalance. Unlike most, this article is not highly technical or difficult to follow; the presentation is simple and orderly and should be understandable to all physicians. In addition the tables will serve as a ready reference for those who are generally unfamiliar with the subject of fluid balance. In short, it is an article which both because of its context and format should be brought to the attention of every reader of this journal.

AIR POLLUTION CONTINUES

In this issue of the *Journal* is an article on the problems of air pollution which Mr. Daley, the Air Pollution Engineer of Providence, read before the Providence Medical Association last spring. It is interesting and provocative reading.

Mr. Daley has the spirit of a crusader. There is little doubt in our minds that the crusaders were rough with the heathen, when the heathen were not being rough with them. He speaks frankly of the efforts of some big organizations to protect their interests, even at the expense of rather poor air for Providence.

We rather think it is necessary to talk out in these crusades. A few years ago the beautiful new courthouse on College Hill was one of the worst offenders in the city as regards air pollution. There were times when one could hardly see across the street in that neighborhood. This was frankly talked about, and we are pleased now that the courthouse is no longer an offender. Mr. Daley tells us that the VA Hospital is now acting in the manner in which the courthouse did. That is a federal institution, and it is not always easy to correct federal ways, but we think Mr. Daley was certainly justified in pointing out their lack of cooperation.

Large organizations are usually averse to changing their ways, and Mr. Daley is not satisfied with the cooperation he gets from soft coal manufacturers. When air pollution control was first organized by the St. Louis city government, they found that the soft coal operators were averse to changes. They went ahead, and they tell us that in the end the soft coal people found the new ways greatly to their advantage.

The ways of the Narragansett Electric Company have been discussed in some detail in this report. Undoubtedly their problems are great, but we believe that anybody who keeps a watchful eye on the large Point Street plant will agree that they are not as yet all solved. There is undoubtedly wisdom in Mr. Daley's remark that "We believe that no utility would spend the money for such complete dust-collecting equipment unless they were 'encouraged' by a strong, public-supported Air Pollution Department."

He goes into some detail about the notorious case of the North Providence bronze foundry which moved to Providence when their fumes were more than the people in the outskirts could bear. At the end of three years of litigation Providence air pollution has not caught up with them.

In a recent edition of *Life* there is shown a catalyzing machine to be installed in chimneys, and the article points out that this apparatus not only eliminates smoke but actually produces valuable heat in so doing. We do not believe that smoke elimination

continued on next page

in the long run is expensive to the organizations who do this.

Mr. Daley says "In Providence we try to correct anything that makes the air unpleasant." Trips through Market Square this summer convinced us that the Providence Air Pollution Division could well work in conjunction with the state's Water Pollution Committee.

THE DOCTOR DRAFT

The completion of physical examinations of approximately 218 priority III physicians under the selective service program this month again highlights the doctor draft situation. All physicians who had not completed fifty years of life on this war-torn globe by last January 1 had to register under the physician draft provisions of the selective service law.

Physicians in priority I and II groups have met the State quota through the months, and with the present demand requiring about one doctor each month the eligibles in these two categories will meet the quota until sometime next Spring when it may be necessary for men in the priority III group to be called up. If the latter contingency arises the youngest men will be taken first for military service.

Like any citizen, a physician may appeal a 1A classification within ten days after notification. The state medical advisory board can offer an opinion regarding the essential need for any physician in any given community based on proof of such need, and that is about all the advisory board can do. The local selective service board has the final say on the drafting of personnel for the services.

One consolation for men in the middle age brackets rests in the fact that each year new physicians completing internships and residencies will be added to the eligible lists, thus lessening the possible demand for priority III physicians. All this, of course, depends upon the progress in the solution of the Korean conflict, and the certainty of no other conflict in some other section of the globe.

To our best knowledge the Services are using to some extent the priority classifications of the selective service system, but they exercise the right to call a reserve officer to duty at any time. Hence the conflicting situation has arisen, and will probably continue to occur, whereby a reserve officer with previous military record may be called to active duty before priority III physicians are tapped by the selective service system.

The "touch and go" state of international affairs lends little hope for an early end of the demand for sizable numbers of physicians to be attendant upon the armed forces. We can only hope that the Korean strife may be terminated within the year, and that somehow, some leadership may arise in the world to destroy the threat to peaceful living.

TAX DEDUCTIONS FOR PROFESSIONAL ASSISTANCE

U. S. Bureau of Internal Revenue has ruled that physicians may deduct from their taxable income the payments they make for "professional assistance" in conducting their practice. Such deductions may be made, the Bureau states in its Bulletin of September 1, 1952, as an ordinary and necessary expense of carrying on a trade or business. The Bureau did not define "professional assistance."

On the question of payments made by a physician, on a split fee basis, to another physician who refers patients to him, the Bureau states that such payments as deductible business expenses must be determined "in the light of all the circumstances in each case." It adds:

> **However, as a general rule, such payments are deductible for Federal income tax purposes provided they are normal, usual, and customary in the profession and in the community; are appropriate and helpful in obtaining business; and do not frustrate sharply defined national or state policies evidenced by a governmental declaration prescribing particular types of conduct.**

A Bureau spokesman explained that the decision sets forth the pattern the Bureau is to follow in the future when ruling on such cases. The ruling cited the U. S. Supreme Court decision in the Thomas B. Lilly case which permitted tax deductions of rebates paid by an optical company to physicians prescribing eyeglasses sold by the firm. *The Bureau Bulletin* (No. 18) is available at Government Printing Office, Washington 25, D. C., at 15 cents a copy.

From the *Capitol Clinic*, Vol. 3, No. 36, of the American Medical Association.

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946
(Title 39, United States Code, Section 233)
SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF
Rhode Island Medical Journal, published monthly at Providence, R. I. for October, 1952.

1. The names and addresses of the publisher, editor, and managing editor are: Publisher, *Rhode Island Medical Society*, 106 Francis Street, Providence, R. I.; Editor, Peter Pineo Chase, M.D., 106 Francis Street, Providence, R. I.; Managing editor, John E. Farrell, Sc.D., 106 Francis Street, Providence, R. I.

2. The owner is: Rhode Island Medical Society, 106 Francis Street, Providence, R. I.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

PETER PINEO CHASE, M. D., *Editor-in-Chief*

Sworn to and subscribed before me this 26th day of September, 1952.

JOHN E. FARRELL, *Notary Public*
(My commission expires June 30, 1956)

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RESEARCH IN THE SERVICE OF MEDICINE

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RHODE ISLAND MEDICAL SOCIETY
October 10, 1952

Where District Society is not listed after the name the Fellow is a member of the Providence Medical Association.

Telephone numbers have been checked with the latest available directories and every effort has been made to insure accuracy.

Any errors in this listing should be reported immediately to the Executive Office of the Society.

KEY TO SPECIALTIES

A—Allergy
ALR—Otology, Laryngology, Rhinology
Anes—Anesthesiology
Bact—Bacteriology
C—Cardiovascular Disease
CP—Clinical Pathology
D—Dermatology
G—Gynecology
GE—Gastroenterology
HAd—Hospital Administration
I—Internal Medicine
Ind——Industrial Practice
N—Neurology
NS—Neurological Surgery
OALR—Ophthalmology, Otology, Laryngology, Rhinology
Ob—Obstetrics
ObG—Obstetrics, Gynecology
Oph—Ophthalmology
Or—Orthopedic Surgery
P—Psychiatry
Path—Pathology
Pd—Pediatrics
PH—Public Health
PL—Plastic Surgery
PM—Physical Medicine
PN—Psychiatry, Neurology
Pr—Proctology
Prev. Med—Preventive Medicine
Pul—Pulmonary Diseases
R—Roentgenology, Radiology
S—Surgery
U—Urology

Information compiled from the American Medical Association Directory, the Directory of Medical Specialists and the Yearbook of the American College of Surgeons.

The name of a physician who *limits his practice* to one field is marked with the appropriate symbol.

A

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Ashworth, Charles J., 184 Angell Street, Providence 6 (S) ..... GA 1-4370
Astle, Christopher J., 31 Allard Street, Conimicut (Oalr) ..... BA 1-0372W

B

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Badway, Joseph M., 549 Broadway, Providence 9 ..... UN 1-2400
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Burgess, Alexander M., Jr., 454 Angell Street, Providence 6 (I) ..... PL 1-2440
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Buxton, Bertram, Jr., 167 Angell Street, Providence 6 (ObG) ..... GA 1-6431

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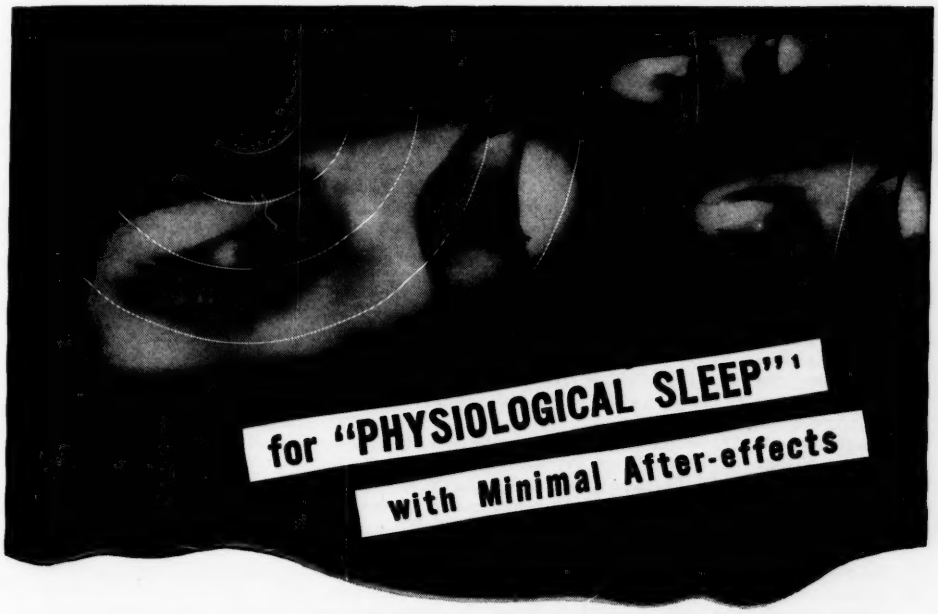

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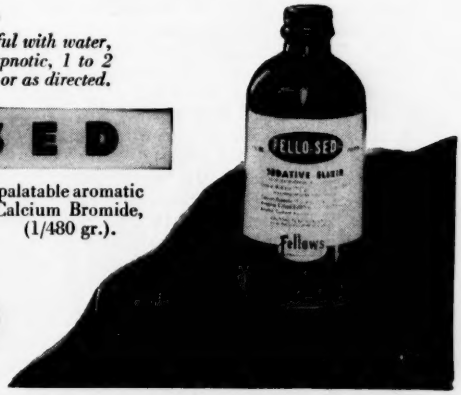

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Earley, Charles P., 388 Prairie Avenue, Providence 5 ..... HO 1-9285
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Eckert, George A., (*Newport*) 130 Touro Street, Newport (S) ..... Newport 35-W
Eckstein, Adolph W., 76 Waterman Street, Providence 6 (S) ..... GA 1-0767
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Eddy, Jesse P., 3rd, 131 Waterman Street, Providence 6 (S) ..... PL 1-4044
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Eliot, Alice M. B., Adams Point, Barrington ..... WA 1-0857
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F

Fagan, James H., 230 Thayer Street, Providence 6 (S) ..... GA 1-7242
Fain, William, 444 Angell Street, Providence 6 (I) ..... GA 1-7271
Falkinburg, LeRoy W., Roger Williams General Hospital, Providence (Path) ..... GA 1-1625
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Feifer, Anthony M., 547 Broadway, Providence 9 ..... UN 1-3915
Feinberg, Banice, 225 Waterman Street, Providence 6 (Pd) ..... UN 1-2242
Felderman, Jacob, 164 Burnside Street, Providence ..... JA 1-5050
Femino, Richard D., 666 Douglas Avenue, Providence 8 ..... UN 1-1433
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Fischer, William J. H., Jr., 154 Waterman Street, Providence 6 (I) ..... GA 1-2676
Fish, David J., 355 Thayer Street, Providence 6 (PN) ..... JA 1-9012
Fish, Vera J. W., 29 Lincoln Avenue, Providence 6 (PN) ..... TE 1-2225
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Fratantuono, Frank D., 106 Vinton Street, Providence 9 (I) (C) ..... PL 1-4493
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Freedman, Stanley S., 183 Waterman Street, Providence 6 (A) (Pd) ..... DE 1-8447
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Fulton, Frank T., 124 Waterman Street, Providence 6 (I) (C) ..... GA 1-3111
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Gershman, Isadore, 343 Thayer Street, Providence 6 (Pd) ..... GA 1-1551
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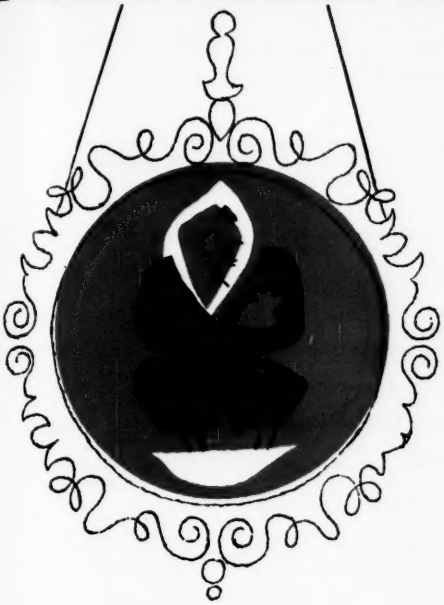

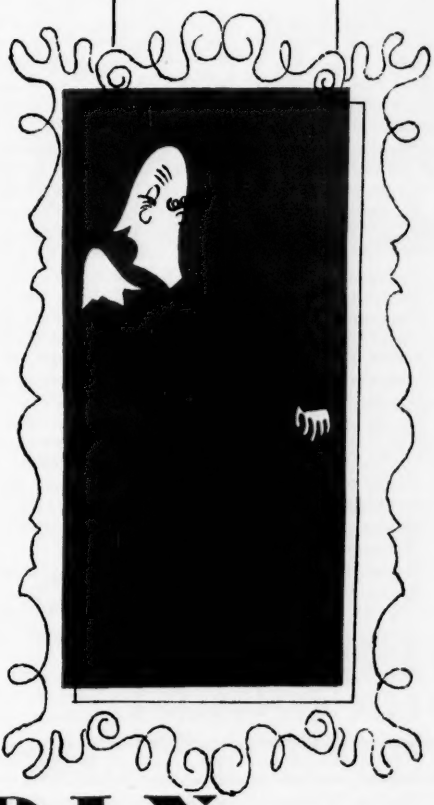

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*Manson, M. H.; Wells, R. L.; Whitney, L. H., and Babcock, C., Jr.: Internat. Arch. Allergy & Applied Immunol. *1*:265, 1951.

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Hindle, Joseph A., 655 Broad Street, Providence 7 (I) ..... DE 1-6310
Hindle, William V., 655 Broad Street, Providence 7 (Or) ..... DE 1-6311
Hoey, Waldo O., 295 Angell Street, Providence 6 (S) ..... PL 1-1300
Hogan, John F., Nashville City Health Department, Nashville 10, Tennessee
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Holdredge, Bertram L., 685 Broad Street, Providence 7 ..... JA 1-2554
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Horvitz, Abraham, 111 Waterman Street, Providence 6 (S) ..... JA 1-9432
Horwitz, Manuel, 407 Brook Street, Providence 6 (R) ..... GA 1-5415
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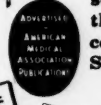

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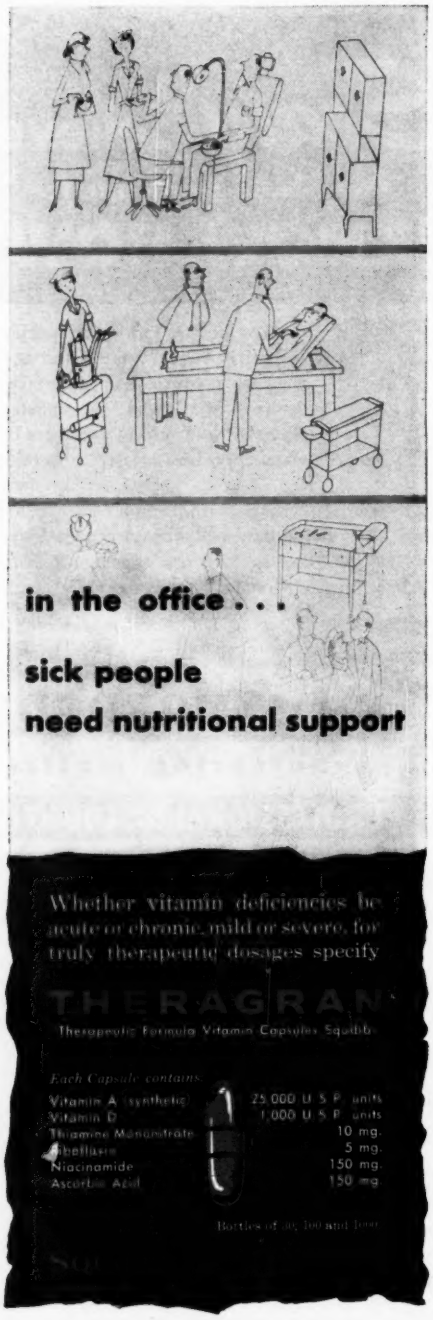
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BOOK REVIEWS

UNTOWARD REACTIONS OF CORTISONE AND ACTH by Vincent J. Derbes and Thomas E. Weiss. Edited by Roscoe L. Pullen. Charles C. Thomas, Publisher. Springfield, Ill. 1951. $2.25.

This fifty-six page monograph is in easy readable form on "Untoward Reactions of Cortisone and ACTH" by Vincent J. Derbes, M.D. and Thomas E. Weiss, M.D.

Reactions are considered from a physiologic and contraphysiologic viewpoint. Undesirable effects are reported in the field of electrolytes, infections, and in the cardiovascular, musculoskeletal, central nervous, and gastrointestinal systems and in the field of dermatology.

For the most part, the information is a short recording of a physiologic or pathophysiologic process as reported by authentic investigators. Nevertheless the contraindications in use of these drugs in terms of the experience of others is clear. The contraindications are in effect weighed against the indications.

The lesson this monograph imparts in terms of contraindications is the need for careful selection of cases in which hormonal therapy is to be used in any given disease.

This monograph provides concise clinical concepts for the physician actually using these modern hormonal preparations and certainly should be recommended reading.

WILLIAM J. O'CONNELL, M.D.

LET'S COOK IT RIGHT by Adelle Davis. Harcourt, Brace & Company, N.Y., 1947. $3.00

"Let's Cook It Right" by Adelle Davis has some simple recipes and interesting comments regarding food preparation which, to an inexperienced cook, could create a desire to become a good cook.

FRANCES L. WARE

LET'S HAVE HEALTHY CHILDREN by Adelle Davis. Harcourt, Brace & Company, N.Y., 1951. $3.00

"Let's Have Healthy Children" by Adelle Davis prepares the expectant mother or mother of children for intelligent consultation with her doctor.

FRANCES L. WARE

PHYSICAL DIAGNOSIS by Ralph H. Major, M.D. W. B. Saunders Company, Phil., 1951. 4th ed. $6.50

Dr. Major, who is also author of "Classic Descriptions of Disease", carries on his interest in medical history into this fourth edition of his textbook, thereby illuminating and making memorable many a fugitive point in the examination of the patient. The text is keyed to the requirements of medical students, but for the experienced physician it provides a useful review. In its lucidity of description and illustration it amply fulfills its instructional intent, and the author's historical perspective provides it with an easy narrative, which is unexpected in a text on physical diagnosis. Worthy of particular mention is the copious use of excellent figures, numbering 469 in a work of 446 pages.

JOHN F. W. GILMAN, M.D.

NEW HEART JOURNAL

A new bimonthly scientific journal, "Circulation Research," the only publication devoted exclusively to reports on fundamental studies related to the heart and circulation, will be issued by the American Heart Association, beginning January 1953, as a further step in the development of its professional education program.

"Circulation Research" will be edited by Dr. Carl J. Wiggers, Professor and Director, Department of Physiology, Western Reserve University School of Medicine, Cleveland. Dr. Robert S. Alexander, Associate Professor of Physiology at the same institution, will be Assistant Editor.

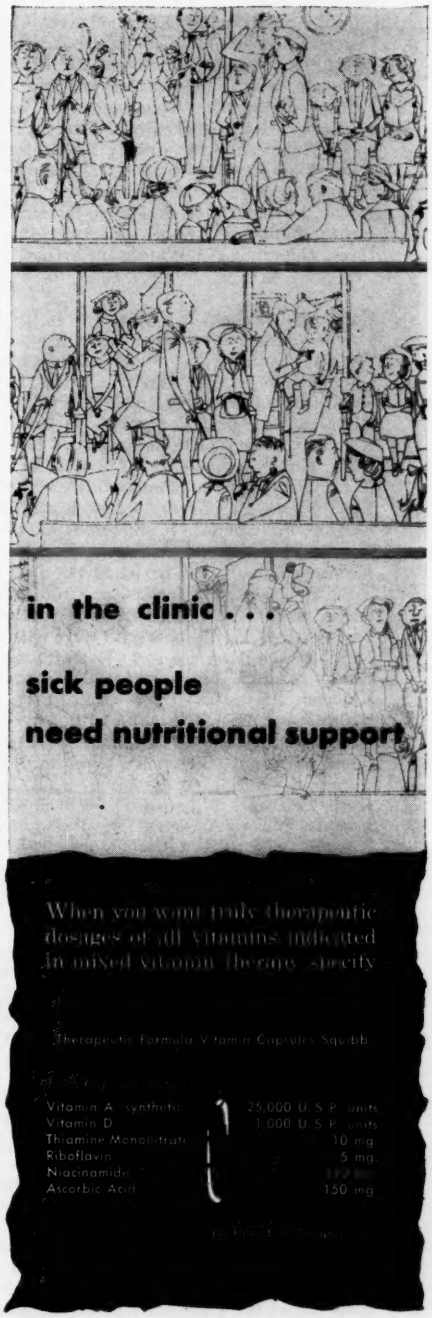
The editor of the new bimonthly expressed the hope that "Circulation Research" would become "the medium for the best in various disciplines of fundamental research that may throw light on cardiovascular problems. These would include anatomic, biologic, biochemical, biophysical, morphologic, pathologic, physical, physiologic, and pharmacologic aspects, regardless of whether they emerge from laboratories of these basic disciplines or from clinical divisions." Dr. Wiggers added, "Since research acquires its full importance only after publication, the new journal will aim to narrow the gap between the completion of a discovery and its publication in the scientific literature."

POSTGRADUATE COURSE IN MEDICINE

The Departments of Medicine of Boston University School of Medicine and Massachusetts Memorial Hospitals have announced a course of clinical lectures and demonstrations for practicing physicians to be given Wednesdays from 2 to 4 p.m., from October 22 to April 29, 1953. Dr. Chester S. Keefer is director.

The purpose of the course will be to demonstrate and discuss the common disorders encountered in medical practice. Modern methods of diagnosis and treatment will be stressed. The course will comprise a total of fifty hours and will comply with the requirements of the American Academy of General Practice.

For further information physicians should write to Dr. James M. Faulkner, Dean, Boston University School of Medicine, 80 East Concord Street, Boston 18.



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Kent, Joseph C., (*Kent*) 10 Post Road, Edgewood 5 ..... WI 1-1820
Kenyon, Frances A., (*Washington*) Woodville Road, Woodville ..... Carolina 18R2
Kenyon, Harold D., (*Washington*) Box 226, Misquamicut Hills, Westerly (Anes) Watch Hill 7137
Keohane, John T., 596 Broad Street, Providence 3 ..... UN 1-1221
Kern, Arthur B., 247 Waterman Street, Providence 6 (D) ..... DE 1-6183
Kiene, Hugh E., 111 Waterman Street, Providence 6 (PN) ..... PL 1-5759
King, Alfred E., (*Woonsocket*) 175 Harris Avenue, Woonsocket ..... Woonsocket 662
King, Arthur W., (*Newport*) Harbor Road, Adamsville ..... Little Compton 452
King, Francis J., (*Woonsocket*) 175 Harris Avenue, Woonsocket (S) ..... Woonsocket 662
Kingman, Lucius C., 76 Waterman Street, Providence 6 (S) ..... DE 1-6138
Kirk, George E., 1337 Smith Street, Providence 8 (ObG) ..... EL 1-3122
Kiven, Nathan J., 111 Waterman Street, Providence 6 (I) ..... PL 1-5759
Klutz, William S., Veterans Administration Hospital, Davis Park, Providence (S) (U) JA 1-1700
Koch, Peter, Jr., (*Kent*) 1451 Main Street, West Warwick ..... VA 1-7313
Kostyla, Edward A., (*Kent*) 15 Washington Street, West Warwick ..... VA 1-2373
Kraemer, Richard J., (*Washington*) 2907 Post Road, Warwick ..... HI 1-1536
Kramer, Louis I., 126 Waterman Street, Providence 6 (I) ..... GA 1-3235
Krolicki, Thaddeus A., (*Pawtucket*) 102 Waterman Street, Providence 6 (Pr) ..... JA 1-9090

L

Ladd, Joseph H., (*Washington*) Exeter School, Lafayette (HAd) ..... Wickford 4
Lagerquist, A. Lloyd, 73 Willett Avenue, Riverside 15 ..... EA 1-4615
Lalonde, Alphonse J., (*Pawtucket*) St. Petersburg, Fla.
Lalor, Thomas J., Jr., (*Woonsocket*) 285 Main Street, Woonsocket ..... Woonsocket 78-W
Lamb, Francis D., (*Kent*) 359 Broad Street, Providence ..... UN 1-5952
Lambiase, Joseph, 199 Angell Street, Providence ..... DE 1-0294
Lamoureux, Stanislas A., (*Pawtucket*) 177 Cove Street, New Bedford, Massachusetts (OALR)
Landsteiner, Ernest K., 154 Waterman Street, Providence 6 (U) ..... JA 1-2223
Langdon, John, 43 Irving Avenue, Providence 6 (Pd) ..... PL 1-7423
Larkin, Donald F., 206 Waterman Street, Providence (Or) ..... JA 1-0121
Laskey, Howard, (*Washington*) Carolina, R. I. ..... Carolina 30
Laufer, Maurice W., Emma Pendleton Bradley Home, Riverside 15 (PN) ..... EA 1-3400
Laurelli, Edmond C., (*Pawtucket*) 156 Broadway, Pawtucket (S) ..... PA 3-5451
Lawson, Herman A., 12 Everett Avenue, Providence 6 (I) ..... PL 1-0784
Lawton, Anne L., State Infirmary, Howard ..... HO 1-3800
Leech, Clifton B., 82 Waterman Street, Providence 6 (C) ..... GA 1-5171
Leet, William L., 84 Brown Street, Providence 6 (I) ..... UN 1-1158
Lent, James W., (*Newport*) 1698 Main Road, Tiverton ..... Tiverton 24-W
Lenzner, Simon G., 187 Waterman Street, Providence 6 (S) ..... DE 1-8710
Levine, Harry (*Woonsocket*) 162 Main Street, Woonsocket ..... Woonsocket 3612-W
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Lewis, Luther R., (*Bristol*) 10 Broad Street, Warren ..... WA 1-1962

Lewis, Robert V., 441 Angell Street, Providence 6 (I) ..... DE 1-8060
Libby, Harold, 223 Thayer Street, Providence 6 (ObG) ..... GA 1-0868
Lippitt, Louis D., 41 Pocasset Avenue, Providence 9 ..... TE 1-2218
Lisbon, Wallace, 928 Smith Street, Providence 8 ..... TE 1-2953
Litchman, David, 225 Waterman Street, Providence 6 (I) ..... UN 1-1563
Littleton, Thomas R., 193 Waterman Street, Providence 6 (ALR) ..... GA 1-2650
Logler, Frank J., (*Newport*) 42 Kay Street, Newport (S) ..... Newport 2498
Londergan, James P., 81 Governor Street, Providence 6 ..... GA 1-4255
Lord, Robert M., 122 Waterman Street, Providence 6 (Pd) ..... GA 1-2163
Lovering, Edwin F., (*Pawtucket*) 209 Broadway, Pawtucket ..... PA 3-5363
Luongo, Fedele U., 508 Charles Street, Providence 4 ..... DE 1-2867
Lupoli, Alphonse W., (*Kent*) 3291 Post Road, Apponaug (I) ..... HI 1-1600-W
Lury, John J., 1424 Broad Street, Providence 5 ..... HO 1-3300
Lynch, John P., (*Pawtucket*) 210 Central Avenue, Pawtucket ..... PA 2-9529

M

MacAndrew, Vincent I., 133 Waterman Street, Providence ..... GA 1-9585
MacCardell, Frank C., 193 Waterman Street, Providence 6 (OALR) ..... DE 1-8433
MacDonald, William J., 221 Thayer Street, Providence 6 (ObG) ..... GA 1-1710
Mack, John A., (*Kent*) 1575 Main Street, West Warwick ..... VA 1-4509
MacLeod, Norman M., 114 Touro Street, Newport ..... Newport 282
Magill, William H., 116 Waterman Street, Providence 6 (G) ..... GA 1-3539
Maher, William F., 949 Chalkstone Avenue, Providence 8 ..... PL 1-1222
Mahoney, George F., State Sanatorium, Wallum Lake (Pul) ..... Pascoag 22
Mahoney, William A., 44 Montague Street, Providence 6 (S) ..... PL 1-1094
Maiello, Robert, 366 Broadway, Providence 3 ..... GA 1-3377
Malinou, Nathaniel J., 334 Smith Street, Providence 8 ..... DE 1-2123
Malone, John M., (*Newport*) 101 Water Street, Portsmouth ..... Portsmouth 47
Mandell, Israel, 50 Oakland Avenue, Providence 8 ..... GA 1-2450
Manganaro, Attilio L., (*Washington*) 745 Kingstown Rd., Peace Dale (Anes) Narragansett 3-3094
Manning, Patrick J., (*Washington*) 1 King Philip Drive, East Greenwich ..... GR 1-3012
Mara, Earl J., (*Pawtucket*) 260 Lonsdale Avenue, Pawtucket (I) ..... PA 2-2301
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Martineau, Lawrence A., Rhode Island Hospital, Providence 2 (R) ..... DE 1-4300
Marzilli, Alexander F., 7 Dexter Street, Providence 9 ..... EL 1-3366
Masse, Omer H., (*Pawtucket*) 19 Crossman Street, Pawtucket ..... PA 5-2880
Mathews, Frank H., 382 Brook Street, Providence 6 (Anes) ..... GA 1-1815
Mathewson, Earl J., (*Pawtucket*) 20 Park Place, Pawtucket (S) ..... PA 5-2688
Mathieu, Peter L., Jr., 255 Waterman Street, Providence ..... JA 1-3231
Matteo, Frank I., 463 Broadway, Providence 9 (ObG) ..... UN 1-3111
Mattera, Vincent J., 425 Broadway, Providence 9 (Anes) ..... UN 1-2526
Mauran, William L., 185 Angell Street, Providence (Pd) ..... DE 1-6507
Maynard, Irene G., (*Kent*) 40 Curson Street, West Warwick ..... VA 1-8154
Maynard, Jean M., (*Kent*) 40 Curson Street, West Warwick ..... VA 1-8154
McAllister, Philip C., (*Newport*) 2 School Street, Newport ..... Newport 588-W
McAteer, Raymond F., (*Washington*) 1880 Broad Street, Cranston 5 (PH) ..... WI 1-6565
McCabe, Francis J., 204 Angell Street, Providence 6 (OALR) ..... PL 1-3675
McCaffrey, James P., 116 Waterman Street, Providence 6 (G) ..... GA 1-6533
McCann, Donald, 112 Waterman Street, Providence 6 (Oph) ..... GA 1-5239
McCann, James A., 207 Waterman Street, Providence 6 (S) ..... GA 1-1862
McCarthy, James M., (*Woonsocket*) 426 Blackstone Street, Woonsocket ..... Woonsocket 44-W
McCaughey, Edward H., (*Pawtucket*) 118 Prospect Street, Pawtucket ..... PA 5-7213
McClellan, George B., (*Pawtucket*) 435 Central Avenue, Pawtucket ..... PA 5-2289
McCooey, James H., (*Woonsocket*) 99 Main Street, Woonsocket ..... Woonsocket 1747
McCusker, Henry F., 167 Angell Street, Providence 6 (Or) ..... DE 1-4901
McDonald, Charles A., 106 Waterman Street, Providence 6 (PN) ..... GA 1-1711
McDonnell, William A., 89 Ravenswood Avenue, North Providence 11 (Anes) ..... TE 1-0425
McDuff, Henry C., Jr., 155 Thayer Street, Providence (ObG) ..... JA 1-3762
McEvoy, Frank E., 295 Angell Street, Providence 6 (S) ..... GA 1-0578
McGovern, Llewellyn J., 162 Indiana Avenue, Providence ..... HO 1-2125
McGrath, James A., (*Washington*) 155 Main Street, Wakefield ..... Narragansett 3-3773
McGuire, John F., 20 Belvidere Road, North Providence ..... JA 1-5951
McIntyre, William A., 1588 Smith Street, North Providence (Anes) ..... EL 3-2433
McKendall, H. Raymond, 454 Angell Street, Providence (Oph) ..... PL 1-2440
McKendry, James R., 568 Hope Street, Providence 6 (Or) ..... GA 1-3272
McKenna, Joseph B., (*Woonsocket*) 162 Main Street, Woonsocket ..... Woonsocket 214-W
McLaughlin, Edward A., 155 Academy Avenue, Providence (PH) ..... DE 1-7470
McNelis, Francis L., 311 Angell Street, Providence (ALR) ..... GA 1-6195
McOsker, Thomas C., Capt., U.S.A., Redstone Arsenal, Huntsville, Ala.
McWilliams, Joseph G., 154 Angell Street, Providence 6 (I) ..... GA 1-4487
Medoff, Edward B., (*Woonsocket*) Room 204, Hospital Trust Building, Woonsocket ..... Woonsocket 804-W
Mellone, John A., (*Bristol*) 15 Bay Spring Avenue, West Barrington ..... WA 1-0682
Melucci, Alfred F., (*Pawtucket*) 113 West Avenue, Pawtucket ..... PA 2-0269
Melvin, Edward G., 369 Broad Street, Providence 7 ..... DE 1-1018
Menzies, Gordon E., 154 West Main Street, Wickford ..... Wickford 2-0230
Merchant, Marcius H., (*Bristol*) 390 Main Street, Warren ..... WA 1-0077
Merlino, Frank A., 377 Hope Street, Providence 6 (Pul) ..... GA 1-6745
Merrill, Whitman, (*Kent*) 99 Main Street, Coventry ..... VA 1-9404
Messinger, Margaret, 4786 Point Loma Avenue, San Diego 7, California (Anes)
Metcalf, Cecil J., 198 Angell Street, Providence 6 (Anes) ..... UN 1-0494
Migliaccio, Anthony V., 196 Broadway, Providence 3 (S) ..... GA 1-4341
Millard, Charles E., (*Bristol*) 673 Main Street, Warren ..... WA 1-0220
Miller, Albert H., 28 Everett Avenue, Providence 6 (Anes) ..... DE 1-5058
Miller, Henry, 194 Waterman Street, Providence 6 (I) ..... UN 1-0832
Miller, Himon, 105 Waterman Street, Providence 6 (PN) ..... GA 1-2541
Mills, Parker, 266 Smith Street, Providence 8 ..... GA 1-1388
Miner, Harold C., 1447 Broad Street, Providence 5 ..... HO 1-2141
Missirlian, Mihran, 188 Broad Street, Providence 3 ..... GA 1-5842
Mochnacky, John, 660 Broad Street, Providence 7 ..... GA 1-4871
Molony, Walter J., 715 Broad Street, Providence 7 (Or) ..... WI 1-1423
Monahan, John T., 160 Academy Avenue, Providence 8 ..... EL 1-0213
Mongillo, Barrito B., 275 Wayland Avenue, Providence 6 (PN) ..... DE 1-5956
Monti, Emilio J., 214 Broadway, Providence 3 ..... GA 1-4239
Monti, Victor H., (*Woonsocket*) 50 Carrington Avenue, Woonsocket ..... Woonsocket 4092
Moor, Henry B., 147 Angell Street, Providence 6 (S) ..... GA 1-3007
Moore, James S., 30 John Street, East Providence 14 ..... EA 1-2074
Moran, James B., 66 Fruit Hill Avenue, Providence 9 (I) ..... EL 1-4661

Morein, Samuel, 345 Angell Street, Providence 6 (I) ..... GA 1-0970
Mori, Laurence A., 55 Pocasset Avenue, Providence 9 ..... TE 1-0500
Morrone, Louis A., (*Washington*) 21 Grove Avenue, Westerly ..... Westerly 2234
Motta, Gustavo A., 164 Academy Avenue, Providence 8 ..... EL 1-5554
Muller, Gertrude L., 193 University Avenue, Providence 6 (PN) ..... DE 1-5398
Mulvey, William A., Ten Rod Road, Lafayette (Pd) ..... Wickford 2-0583
Muncy, William M., 162 Angell Street, Providence 6 (OALR) ..... GA 1-4385
Murphy, John F., 289 Angell Street, Providence 6 (ObG) ..... GA 1-0455
Murphy, Robert G., 184 Angell Street, Providence 6 (I) ..... DE 1-3424
Murphy, Thomas H., 169 Waterman Street, Providence 6 ..... UN 1-2551
Myrick, John C., 572 Broad Street, Providence 7 (S) ..... EL 1-1221

N

Nardone, Girard F., (*Washington*) 4 Elm Street, Westerly ..... Westerly 4230
Nathans, Samuel (*Washington*) Watch Hill Road, Westerly (Anes) ..... Westerly 2279
Nerone, William S., 21 Bullocks Point Avenue, East Providence 15 ..... EA 1-4462
Nestor, Thomas A., (*Washington*) Main Street, Wakefield (S) ..... Narragansett 3-4762
Nevitt, Francis W., 575 Pontiac Avenue, Cranston 10 ..... HO 1-3500
Nichols, Ira C., Berkeley, California (PN)
Nodarse, Raul, 912 Manton Avenue, Providence ..... EL 1-8684
Normandin, Louis A., 240 Taunton Avenue, East Providence 14 ..... EA 1-1100
Nourie, Joseph P., 1339 Smith Street, Centerdale 8 ..... EL 3-2715
Noyes, Ira H., 199 Benefit Street, Providence 3 (G) ..... DE 1-7585

O

O'Brien, James P., (*Woonsocket*) 70 North Main Street, Woonsocket (PH) Woonsocket 3665
O'Brien, John H., 95 Taunton Avenue, East Providence 14 (S) ..... EA 1-0092
O'Brien, Martin, (*Washington*) 13 Champlin Street, Wickford ..... Wickford 2-0995
O'Brien, William B., State Sanatorium, Wallum Lake (Pul) ..... Pascoag 22
O'Connell, Francis D., 215 Thayer Street, Providence 6 (S) ..... GA 1-3768
O'Connell, Joseph C., 215 Thayer Street, Providence 6 (S) ..... GA 1-9046
O'Connell, Thomas L., 359 Broad Street, Providence 7 (OALR) ..... GA 1-3321
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Oddo, Vincent J., 322 Broadway, Providence 9 (U) ..... GA 1-1461
O'Reilly, Edwin B., 737 Smith Street, Providence 8 ..... DE 1-1132
Orlando, Lorenzo, 1235 Cranston Street, Cranston ..... JA 1-1125

P

Pahigian, Vahey M., 323 Angell Street, Providence 6 ..... JA 1-9870
Palmer, William H., 103 Betsey Williams Drive, Cranston (Ind) ..... WI 1-7921
Palumbo, Joseph A., 118 Pocasset Avenue, Providence 9 ..... EL 1-1916
Pardee, Katherine, State Sanatorium, Wallum Lake (Pul) ..... Pascoag 22
Parkinson, James M., 497 Hope Street, Providence 6 ..... PL 1-3017
Parrillo, Joseph M., 376 Broadway, Providence ..... UN 1-6556
Partridge, Herbert G., 190 Angell Street, Providence 6 (Ob) ..... GA 1-5544
Paterson, John A., Veterans Administration Hospital, Togus, Maine (PN)
Pearson, Rudolph W., 300 Thayer Street, Providence 6 (ALR) ..... UN 1-2224
Pedorella, Americo J., 242 Broadway, Providence 3 (Anes) ..... GA 1-8218
Pelletier, Emery, 20 Peace Street, Providence ..... PL 1-4223
Penington, Robert, Jr., U. S. Naval Academy, Annapolis, Maryland
Perry, Thomas, Jr., 154 Waterman Street, Providence 6 (S) ..... DE 1-1717
Pesare, P. Joseph, 1250 Smith Street, Providence (Prev. Med) ..... EL 1-3721
Petrucci, Ralph J., (*Bristol*) 88 Child Street, Warren ..... WA 1-1121-W
Phillips, Charles L., (*Kent*) 294 Main Street, East Greenwich ..... GR 1-0175
Pianka, Wallace J., U. S. Veterans Hospital Annex, Vancouver, Washington
Pickles, Wilfred, 184 Waterman Street, Providence 6 (S) (NS) ..... GA 1-1228
Pinault, William N., (*Pawtucket*) 831 Newport Avenue, Pawtucket ..... PA 2-8474
Pitts, Herman C., 68 Brown Street, Providence 6 (S) ..... GA 1-4121
Platt, Marden G., (*Pawtucket*) 319 Willett Avenue, Riverside 15 ..... EA 1-3836
Porter, Arnold, 454 Angell Street, Providence 6 (S) ..... PL 1-2440
Porter, Emery M., 454 Angell Street, Providence 6 (S) ..... PL 1-2440
Porter, Lewis B., 199 Thayer Street, Providence 6 (OALR) ..... GA 1-3970
Portnoy, Bradford M. S., 672 Broad Street, Providence 7 ..... GA 1-4235
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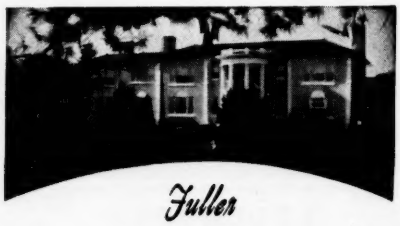

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Potter, Walter H., 68 Jackson Street, Providence 3 ..... GA 1-4476
Pournaras, Nicholas A., 499 Elmwood Avenue, Providence 7 ..... WI 1-3022
Pozzi, Gustave, 209 Waterman Avenue, East Providence 14 ..... EA 1-0330
Prior, James H., 1738 Broad Street, Providence 5 (I) ..... HO 1-1414
Pritzker, Samuel, 26 Alfred Stone Road, Providence (Anes) ..... GA 1-1221

Q

Quesnel, Ernest, 512 Park Avenue, Cranston (PN) ..... ST 1-2562

R

Rakatansky, Nathan S., 34 Old Tannery Road, Cranston (Anes) ..... PL 1-7821
Ramos, Jose M., (*Newport*) 28 Kay Street, Newport ..... Newport 85
Randall, Arthur G., (*No district society*) 511 Westminster Street, Providence 3 ..... GA 1-2614
Raphael, Sumner, 174 Waterman Street, Providence 6 (ObG) ..... DE 1-3585
Rapoport, Bernard, 225 Waterman Street, Providence 6 (I) ..... DE 1-1934
Rattenni, Arthur, 1011 Smith Street, Providence 8 ..... EL 1-1011
Reeves, James A., 1404 Broad Street, Providence 5 ..... HO 1-2224
Regan, John F., State Hospital for Mental Diseases, Howard (PN) ..... HO 1-4700
Rego, Rodrigo P. C., 103 Governor Street, Providence 6 ..... DE 1-7753
Reich, Jacob, 430 Prairie Avenue, Providence 5 ..... WI 1-3661
Reid, William A., 300 Thayer Street, Providence 6 (ObG) ..... GA 1-3300
Reilly, Joseph W., (*Woonsocket*) 113 Main Street, Woonsocket (I) ..... Woonsocket 242-R
Reik, Louis, Butler Hospital, Providence 6 (PN) ..... GA 1-3456
Ricci, Edward A., 4 Thomas Street, North Providence 11 ..... CE 1-4795
Rice, William O., State Infirmary, Howard (HAd) ..... HO 1-3800
Richardson, Ralph D., 154 Waterman Street, Providence 6 (S) ..... UN 1-9056
Riemer, Robert W., 183 Angell Street, Providence 6 (S) ..... DE 1-8280
Riley, Clarence J., 507 Manton Avenue, Providence 9 ..... TE 1-2300
Ripley, Frederic W., Jr., 167 Angell Street, Providence 6 (ObG) ..... DE 1-3117
Rittner, Mark, 171 Reservoir Avenue, Providence (OALR) ..... WI 1-5577
Roberts, William H., 448 Hope Street, Providence 6 ..... DE 1-1535
Robinson, Mildred I., (*Washington*) 21 Grove Avenue, Westerly ..... Westerly 2234
Robinson, Nathaniel D., 112 Waterman Street, Providence 6 (Oph) ..... TE 1-1214
Robinson, Robert C., 133 Waterman Street, Providence 6 (Or) ..... GA 1-1892
Rocco, Albert F., U.S.A.F.R., Station Hospital, Sampson Air Base, New York
Rocheleau, Walter C., (*Woonsocket*) 38 Hamlet Avenue, Woonsocket (S) ..... Woonsocket 2067
Rohr, Mary-Elaine J., (*Pawtucket*) 358 Pawtucket Avenue, Pawtucket ..... PA 2-2425
Romano, Anthony, 462 Broadway, Providence 9 ..... UN 1-3577
Ronchese, Francesco, 170 Waterman Street, Providence 6 (D) ..... GA 1-3004
Ronne, George E., (*Pawtucket*) 49 Fountain Street, Pawtucket ..... PA 3-0054
Roque, John A., 952 Park Avenue, Cranston 10 (I) ..... WI 1-1131
Rosin, Robert, 105 Waterman Street, Providence 6 (R) ..... JA 1-1441
Ross, Florence M., 55 Bluff Avenue, Providence 5 ..... WI 1-7868
Ross, Milton G., 355 Thayer Street, Providence 6 (Oph) ..... GA 1-8671
Rossi, Matthew W., 784 Park Avenue, Cranston 10 ..... WI 1-8688
Rossignoli, Vincent P., 201 Broadway, Providence 3 ..... DE 1-2358
Roswell, Joseph T., (*Woonsocket*) 50 Providence Street, Woonsocket (Anes) Woonsocket 74
Rotelli, Anthony J., 420 Angell Street, Providence ..... JA 1-3212
Round, Charles B., 2171 Warwick Avenue, Warwick (S) ..... BA 1-0324
Rounds, Albert W., 511 Westminster Street, Providence 3 ..... GA 1-2927
Rozzero, Paul J., 176 Webster Avenue, Providence 9 ..... EL 1-3609
Ruggles, Arthur H., Butler Hospital, Providence 6 (PN) ..... GA 1-3456
Ruhmann, Edward F., 1711 Broad Street, Cranston 5 ..... HO 1-5523
Ruhmann, Warren H., (*Kent*) 4500 Post Road, East Greenwich ..... GR 1-0007
Ruisi, Joseph L. C., (*Washington*) 21 Elm Street, Westerly ..... Westerly 4281
Russell, Amy E., 651 Warren Avenue, East Providence 14 ..... EA 1-0090-R
Ryan, J. Frank, 1397 Broad Street, Providence 5 ..... WI 1-1232
Ryan, Vincent J., 198 Angell Street, Providence 6 (D) ..... GA 1-4313

S

Sage, Louis A., 122 Waterman Street, Providence 6 (Or) ..... GA 1-8435
St. Angelo, Joseph A., 1891 Smith Street, North Providence 11 ..... CE 1-5100
Saklad, Elihu, 154 Waterman Street, Providence 6 (Anes) ..... GA 1-0026
Saklad, Meyer, 154 Waterman Street, Providence 6 (Anes) ..... GA 1-0026
Saklad, Sarah M., 153 Morris Avenue, Providence 6 (PN) ..... GA 1-0477
Saltzman, Abraham, 155 Angell Street, Providence 6 (I) ..... DE 1-2110
Sammartino, Agostino, 257 Academy Avenue, Providence 8 ..... UN 1-7274

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Sanborn, Harvey B., 34 Drowne Parkway, East Providence (PN) ..... EA 1-2205
Sannella, Lee G., 124 Waterman Street, Providence 6 (OALR) ..... GA 1-9433
Sarafian, John C., 593 Broad Street, Providence 7 ..... DE 1-1146
Sargent, Francis B., 124 Waterman Street, Providence 6 (ALR) ..... GA 1-4422
Savastano, Americo A., 205 Waterman Street, Providence 6 (Or) ..... GA 1-4538
Savran, Jack, 295 Angell Street, Providence 6 (S) ..... PL 1-2112
Sawyer, Carl D., 184 Waterman Street, Providence 6 (D) ..... GA 1-1582
Sawyer, Carl S., 184 Waterman Street, Providence 6 (D) ..... DE 1-3355
Sayer, Edmund A., 148 Waterman Street, Providence 6 (S) ..... PL 1-0148
Scanlan, James J., 42 Elmcrest Avenue, Providence ..... EL 1-1441
Scanlan, Michael H., (*Washington*) 88 High Street, Westerly ..... Westerly 2190
Scanlon, Thomas F., 366 Atwells Avenue, Providence 3 (S) ..... GA 1-0847
Schiff, Bencel L., (*Pawtucket*) 251 Broadway, Pawtucket (D) ..... PA 5-3175
Schradieck, Constant E., P. O. Box 98, Newton Highlands, Massachusetts (Path)
Schwab, William J., 616 Hope Street, Providence 6 ..... DE 1-1279
Scotti, Ciro O., 770 Providence Street, West Warwick ..... VA 1-5606
Segall, Werner, 155 Angell Street, Providence 6 (I) ..... JA 1-1801
Sellman, Priscilla, 21 Lorimer Avenue, Providence 6 (Anes) ..... PL 1-6234
Seltzer, Bernard B., 409 South Federal Highway, Hollywood, Florida
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Senseman, Laurence A., (*Pawtucket*) 1189 Smithfield Avenue, Lincoln (PN) ..... PA 5-4484
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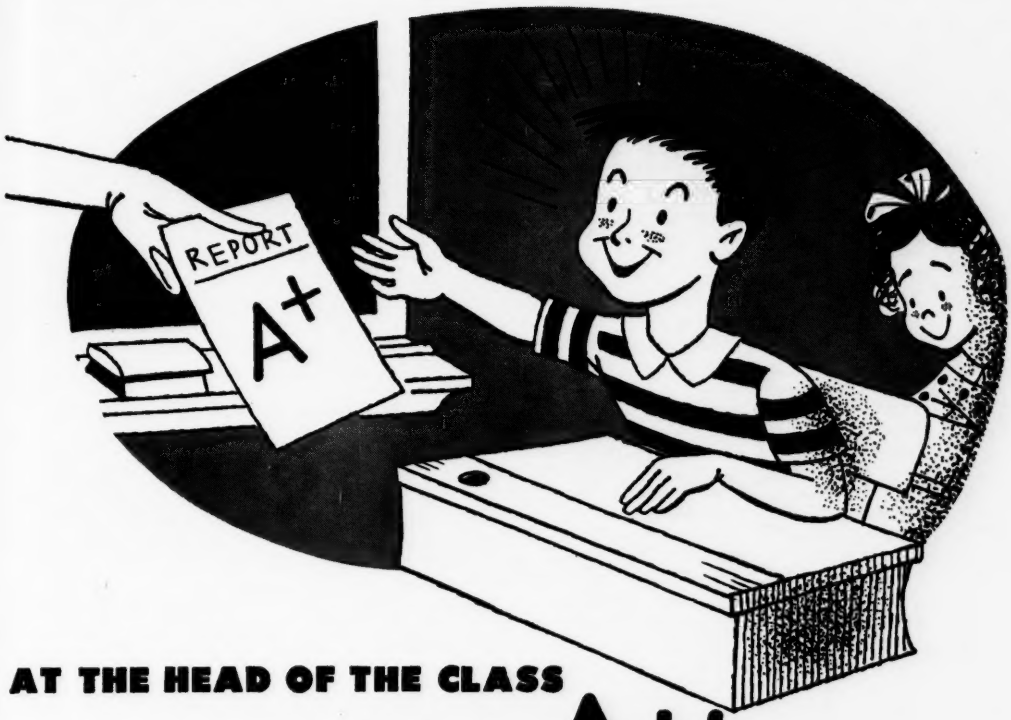

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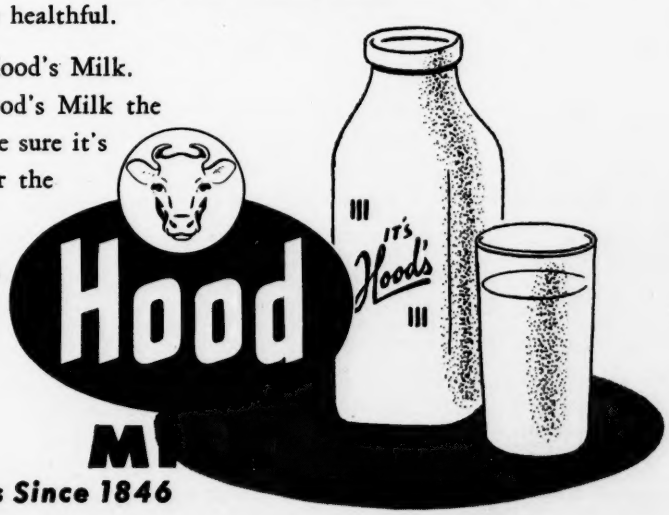

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Tetreault, Adrien G., (*Pawtucket*) 650 Central Avenue, Pawtucket PA 5-7955
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ADMINISTRATIVE PROBLEMS IN AIR POLLUTION CONTROL IN PROVIDENCE

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and cinders that a manufacturer is storing on adjacent property. The storage piles slope right down against their back yard fences and the women tell us that the fine dust is being blown into their homes. This is an air pollution problem but we have nothing in our ordinance to handle it.

We need revised and stronger air pollution ordinances, but can we depend on the soft coal people and the Manufacturing Chemists' Association to write them for us?

Most of our downtown buildings are equipped with photoelectric audio smoke alarms. These alarms instantly warn the power plant operator of wasteful smoke and they are self-amortizing through fuel savings. Shouldn't consideration be given to making these money saving alarms mandatory in big boiler plants?

One of the biggest problems is private incineration and open fires. We don't know of one apartment house or hotel whose incinerator is not a chronic offender. Studies are being made on how to cope with these nuisances.

This business of cleaning the air in cities has just begun to roll slightly since the last war. The answers are not available in books, so we in Providence have had to find them out for ourselves. So far we believe that our rulings have been proved sound. When we became America's only city to ban the hand-firing of soft coal we automatically cleaned up hundreds of stacks. If our advisory board decides in favor of other strict rulings, we may incur the wrath of small selfish groups, but we'll be making the air purer for our citizens.

We'll never be able to make the Providence atmosphere as clean as Block Island's, but we can work with that objective in mind.

If we continue to enjoy the support of spirited citizens, civic groups and fine organizations such as the Providence Medical Association, some day we'll merit the title of "PROVIDENCE, THE CLEAN AIR CITY."

ANESTHESIOLOGISTS ELECT

At the regular meeting of the Rhode Island Society of Anesthesiology the following members were elected as officers:

President: Nathan S. Rakatansky, M.D.
Vice President: Harry E. Darrah, M.D.
Secretary-Treas.: Edward Damarjian, M.D.

WEDNESDAY, DECEMBER 10

INTERIM MEETING

of the

RHODE ISLAND MEDICAL SOCIETY

at the

LEDGEMONT COUNTRY CLUB

* * *

Scientific Program: 4:00 p.m.

Dinner: 7:00 p.m.

Dinner Speaker –

LOUIS H. BAUER, M.D.

President

The American Medical Association

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